Mining CONGRESS JOURNAL

FEBRUARY
1957

ANNUAL MINING REVIEW

DENVER CAN SUPPLY COMPLETE EQUIPMENT FOR YOUR MILL

One Responsibility

Crushers, Screens, Feeders, Ball-Rod Mills, Classifiers, Jigs, Pumps, Samplers, Agitators, Conditioners, Flotation, Thickeners, Filters, Dryers, Ore Testing and Mill Design Services.

How DENVER SRL (Soft Rubber Lined) PUMPS CAN CUT YOUR PUMPING COSTS...for abrasive pulps or tailings

1. POWER COSTS CUT

Denver SRL Pumps often use less than one-half the brake horsepower required by other pumps in similar service. This is the result of simplified design and high efficiency of molded rubber parts. **This means substantial savings for you in power costs and maintenance.**

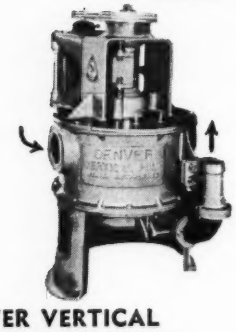
2. SHUTDOWN TIME REDUCED

Because molded rubber parts are highly resistant to corrosion and abrasion, case history records show where Denver SRL parts lasted up to 15 times longer than parts on pumps previously on the same service. This means increased production, savings for you in maintenance costs—and, more important, reduced down time.

3. A PUMP FOR EVERY JOB

Denver SRL Rubber Lined Pumps are available to you for standard or heavy duty service and with capacities up to 2400 g.p.m. You can choose exactly the right pump that will do your pumping job most efficiently, most economically. Parts for all sizes are kept in stock for fast service.

If you have abrasive or corrosive material to pump, you can make substantial savings by using Denver SRL Rubber Lined Pumps. For complete information about what Denver SRL pumps can do for you, **WRITE TODAY FOR FREE BULLETIN P9-B8. MOST SIZES OF SRL PUMPS IN DENVER STOCK.**



DENVER VERTICAL CENTRIFUGAL SAND PUMP . . . for use where

1. Feed is intermittent.
2. Pulp is frothy or air laden.
3. Feed varies in density.
4. Floor space is limited.
5. Plant portability is an advantage.
6. Long life is a factor.
7. Initial cost must be minimum.
8. Feed sump is impractical.

Sizes from ¾" to 4". Also Denver Adjustable Stroke Diaphragm Pumps from 2" to 8", simplex and multiple units.

For complete information, WRITE FOR BULLETIN NO. P10-B5.

"The firm that makes its friends happier, healthier and wealthier"

DECO ENGINEER — DENVER EQUIPMENT 24 HOUR SERVICE COMPANY

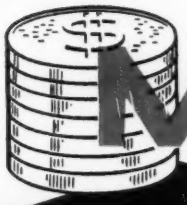
DENVER EQUIPMENT CO.

1400 Seventeenth St. • Denver 17, Colorado

DENVER • NEW YORK • CHICAGO • VANCOUVER • TORONTO

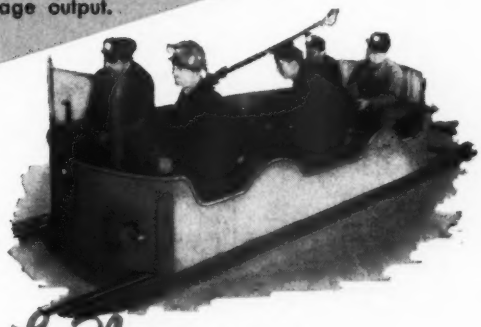
MEXICO, D. F. • LONDON • JOHANNESBURG

Time is Money - SAVE IT



with the Lee-Norse BUS & JITNEY

Take a real good look at these LEE-NORSE "TIME-SAVERS"! Like modern misers they hoard minutes into extra productive hours by cutting portal to portal time—reducing costs—increasing tonnage output.



Lee-Norse MINE PORTAL BUS

(Locomotive Type)

This self-propelled Portal Bus for hauling section production crews to and from the face is unique with its split roof construction giving the driver an unimpeded, all directional view . . . the trolley is always within easy reach of the operator. Our standard low and high type Portal Bus operates in the majority of coal mines and will haul from 13 to 20 Men. This Portal Bus is powered with one (1) large motor (15 H. P.) and has two (2) independent braking systems for complete safety — (airplane-type) disc brakes hydraulically operated on each axle and dual mechanical hand operated service brakes on each wheel.

TIME IS MONEY — SAVE IT with the Lee-Norse Mine Portal Bus!

Lee-Norse JITNEY

Wherever they're in use—they're regarded as a time saving asset. Fleet and versatile the Jitney furnishes quick, sure transportation to and from the working face for key personnel, inspectors, engineers, etc. When required the Jitney can be pressed into service as an ambulance and is suitable for pulling fire fighting equipment.

TIME IS MONEY — SAVE IT with the Lee-Norse Jitney.

Write NOW for Literature

Lee-Norse Company

CHARLEROI, PA.

DESIGNERS AND BUILDERS OF THE FAMOUS LEE-NORSE MINER

push your coal production UP

with this hard-working JEFFREY team

Jeffrey 70-UR Universal Cutter for bottom, top and shear cuts

Head and cutter can be rotated 360° in either direction and positioned to make any kind of cut, any place in the seam. From one location, the 70-UR Cutter makes a 30-foot horizontal cut (using a 9-foot cutter bar) or a shearing cut 5'5" to either side of the machine's centerline. No wonder mine superintendents brag about its tonnage-producing ability!

Operators report smooth and positive traction for sumping, even when cutting at extreme range. The 70-UR's wide wheel gauge, long wheel base, low center of gravity and large pneumatic tires give sure-footed stability. Maintenance men say that its rugged construction reduces downtime and cuts upkeep costs.

Jeffrey 81-A Loader for high capacity loading

From both a production and a maintenance standpoint, the 81-A Loader is a superior machine. It is well balanced and flexible, and is easily maneuvered; trams at 137 FPM and can be turned in its own length. The conveyor swings 45° either side of center and elevates properly to load shuttle cars on the straight and in break-throughs. It has a rated capacity of 8 TPM and a maximum capacity of 10 TPM.

Maintenance is simplified on the Jeffrey 81-A Loader because every motor and gear case is a separate, detachable unit. This kind of unit construction is used throughout, resulting in rapid replacements and lower upkeep costs.

Jeffrey 56-FHR Face Drill for shot hole drilling

This single-boom drill provides a high degree of operating flexibility. It is rubber-tire-mounted and self-propelled by two hydraulic motors. Another operates the cable reel. The drilling head can be swung by finger-tip control to any desired position for shot hole placement. Drilling range is 7′2⅝″ vertically and 13′1¾″ horizontally.

The auger can be withdrawn by power without reversing the direction of rotation of the auger. This action clears the hole of all cuttings, leaving it ready for insertion of the powder or blasting cartridge.

OTHER JEFFREY EQUIPMENT FOR UNDERGROUND SERVICE:

Continuous Mining Machines • Conveyors • Shuttle Cars • Locomotives • Fans and Blowers
Descriptive literature sent upon request. The Jeffrey Manufacturing Co., Columbus 16, Ohio

JEFFREY

MINING • CONVEYING • PROCESSING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

Mining

CONGRESS JOURNAL

Member
Audit Bureau of Circulation

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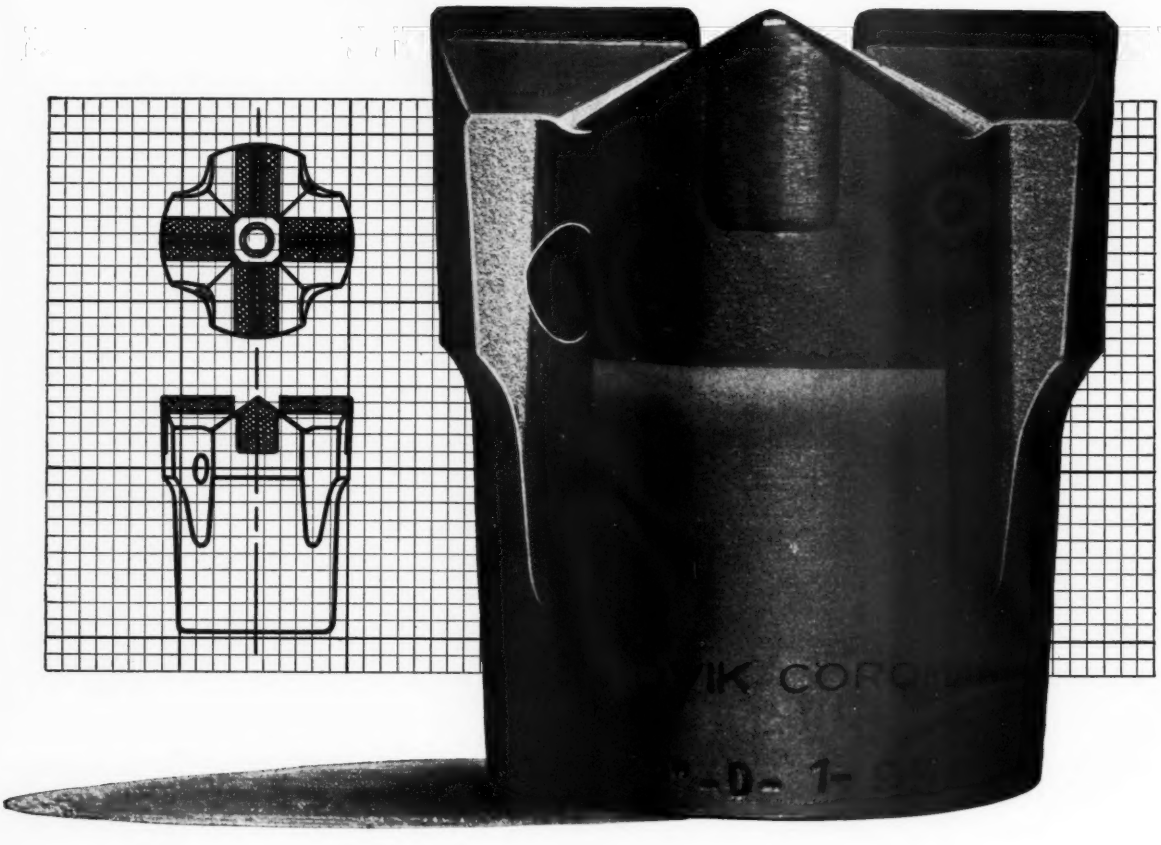
CONTENTS

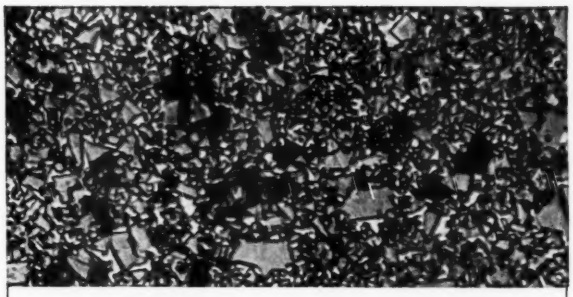
THIS ROCK BIT IS PRECISION-MADE FOR A HIGHER PERFORMANCE



Nothing tougher and more wear-resistant than the insert of a Sandvik Coromant 776 bit

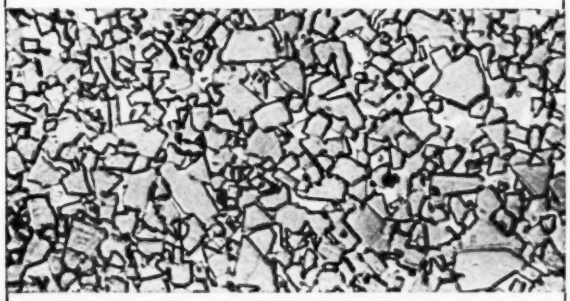
Rock bits that go on *and on* must have highest-grade tungsten-carbide inserts. Nothing but tungsten carbide in its purest state is good enough, will last as long. That's why the carbide that goes into a Sandvik Coromant 776 bit is meticulously controlled.

Sandvik, the world's largest manufacturers of brazed-in tungsten-carbide inserts for rock drilling, control every phase of production. Coromant carbide is scrutinised for impurities from the very first stages of processing the tungsten ore, right through to the final inserts. Add to that Sandvik's special process of securing the insert to the body, employing an exceptionally strong bonding metal, and you know why a Coromant 776 bit lasts longer. In 1955, one billion feet were drilled with these inserts, all fitted to Sandvik Coromant bits or integral steels. *Nothing is more conclusive of the quality of Coromant bits than this figure.*



LOW QUALITY TUNGSTEN CARBIDE

These are unretouched, 1200-times enlarged microphotos. Above, carbide full of impurities. Those black marks are contaminations which are present when production and quality control are deficient. Contamination of this kind weakens the carbide and reduces its working life.



SANDVIK COROMANT TUNGSTEN CARBIDE

This is Coromant carbide. Notice the uniformity of size and the even distribution of grain. Coromant inserts are free of dangerous porosity and impurities—the reason they go further, have greater strength.

Nothing stands the strain like the Swedish body of a Sandvik Coromant bit

When you put the strongest possible tungsten carbide into a rock bit, the body has to be the strongest available to take the extra strain. That's why Coromant bodies are made of high-quality Swedish alloy steel. But that's not all. Inserts and clearance are cylindrically-ground and the insert ends precision-tooled to exactly the same height. This means *smoother* drilling and *smoother* holes, because the load is equally distributed on all four inserts. *Precision engineering such as this give Coromant bits a longer life!*

Nothing fits like the precision-milled threads of a Sandvik Coromant bit

In order to get a smooth profile of the highest accuracy, Coromant threads are precision-milled in a special thread-milling machine and not made with a tap. Precision-milling too protects the skirt from common fatigue failures.

SANDVIK COROMANT 776 BITS

and Sandvik Coromant integral steels are available in standard sizes through Atlas Copco, who, in their own field, are the world's largest manufacturers of rock drills. Contact any of these offices *today* for further information and a demonstration.

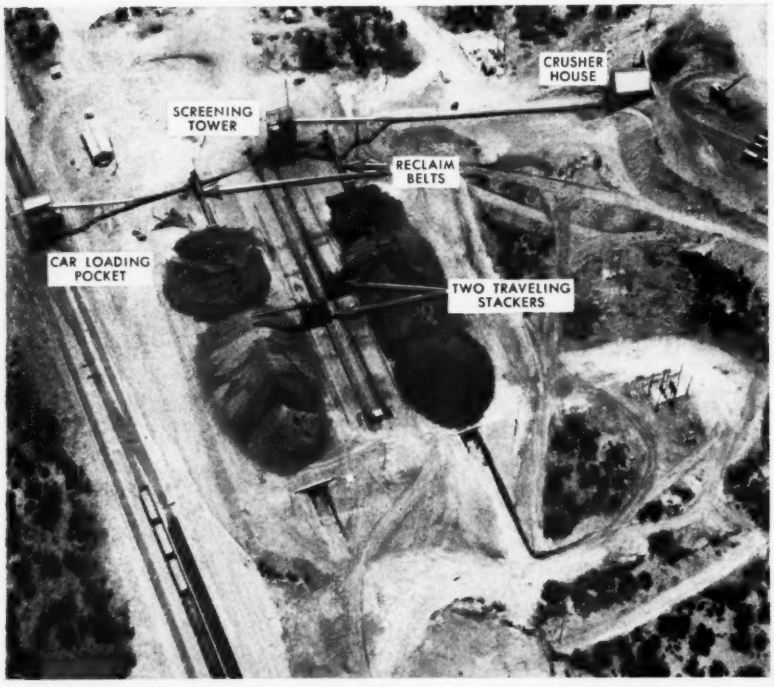
U.S., Atlas Copco Pacific, Inc., 930 Brittan Avenue, San Carlos, California. Atlas Copco Eastern Inc., P.O. Box 2568, Paterson 25, N.J.
CANADA, Atlas Copco Canada Ltd., Montreal, Airport, P.Q.
MEXICO, Atlas Copco Mexicana S.A., Apartado Postal 56, Torreon, Coahuila.

Atlas Copco

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment

LINK-BELT conveyors help Comstock Mine

control stockpiling, blending of ore by push-button



SMOOTHLY INTEGRATED Link-Belt ore handling system at Comstock Mine of The Colorado Fuel and Iron Corporation conveys ore from crusher house to storage and railroad spur, with screening and sizing performed en route. Mine is operated by Utah Construction Company.

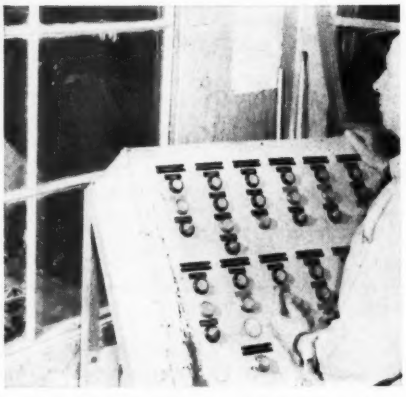
Integrated system moves 1000 tph to storage . . . reclaims 1500 tph

THE latest in modern ore handling techniques are incorporated in the Link-Belt engineered system at Comstock Mine, Iron Mountain, Utah. A single operator uses push-button controls to direct operation of seven belt conveyors, a vibrating screen, two traveling stackers and various gates and chutes—regulating stockpiling, blending and delivery of ore to railroad cars.

If any phase or all of your ore handling requires modernization or mechanization—call your nearby Link-Belt office. Here is a broad line of equipment, backed by unrivalled engineering facilities—your assurance of lowest cost per ton handled.

LINK-BELT

CONVEYING AND SCREENING EQUIPMENT



EXTREME FLEXIBILITY is possible through seven settings of the flow selector switch, which permits controlled distribution to storage and car loading conveyors.

STOCKPILING ORE BY GRADE with one of two belt conveyors and traveling stackers. In reclaiming, various grades of ore are blended to meet blast furnace requirements.

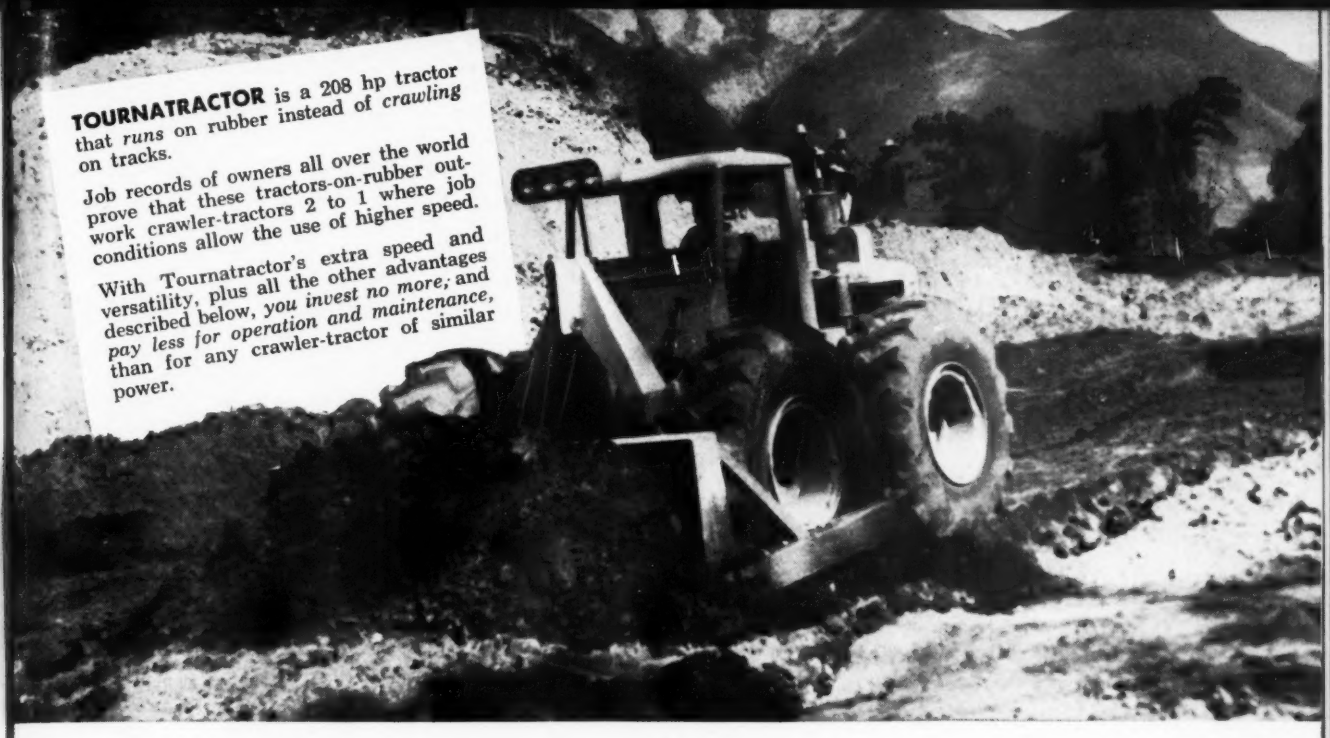
CAR-LOADING BELT CONVEYOR beneath screening tower is fed by two reclaim tunnel belts, or by upper conveyor from crusher house which can bypass stockpile.

LINK-BELT equipment at Comstock Mine

- Feeders
- Scalpers
- Belt conveyors
- Vibrating screens
- Traveling stackers
- Tunnel gates
- Drives
- Controls

14,485

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



Does speed fit your job?

Check these tractor advantages

17 mph forward . . . 8 in reverse

Tournatractor pulls, dozes, pushes at working speeds 2 to 3 times faster than crawler-tractors. You change gears instantly, waste no time shifting, move up to 8 mph in reverse. Torque converter provides the equivalent of an infinite number of gear ratios, automatically selected to balance load and torque.

Drives to work . . . anywhere

Tournatractor travels at speeds to 17 mph from job-to-job. Big, low-pressure tires drive anywhere without need for planking, trailers, loading or unloading.

Simple . . . less maintenance

Lubrication takes less than 5 minutes on Tournatractor, compared to 15 minutes or more on a crawler. Cleaning of tracks and fittings is eliminated. Self-cleaning tires last 2 to 3 times longer than tracks.

Anti-friction drive

208 hp diesel drives through dirt-sealed anti-friction bearings to free-rolling wheels. There is no grinding wear of sand, dirt, and mud as in driving with multi-part crawlers.

Provides emergency electric power

Flywheel-mounted generator produces electricity to operate blades and PCU, and in emergencies you can tap into this handy electric source for floodlights, power tools.

Easier to operate

Less jolt and jar on low-pressure rubber tires reduces stress and strain on both operator and machine. Simple electric controls permit operator to work faster, with less end-of-day fatigue.

Improves safety

Low center of gravity, all-around visibility, accessibility, and quick response of electric controls make Tournatractor exceptionally safe to operate. Its multi-disc air brakes have *four times* the braking surface of most big tractors and trucks.

Interchangeable equipment

Bulldozer, Angledozer, Root Rake, Snow Plow, Snow Wing, Push Block, Logging Winch, Tree Pusher, are also available.

Ask your LeTourneau-Westinghouse Distributor to help you analyze specific Tournatractor applications on your work. No obligation!

Tournatractor, Angledozer — Trademark Reg. U.S. Pat. Off. T-941-M-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

Helps gloss pages of nation's top magazines

Rear-Dump hauls heaped loads over deeply-rutted mine floor. Rig keeps going steadily through soft footing, takes minutes off each cycle...hauls up to 42 loads in one day!

Low rear-entry and wide bowl provide easy target for shovel operator... make for fast swingout of shovel dipper, let operator heap maximum yardage with minimum spillage.

At touch of electric switch, body lifts, swings below and behind rear wheels...prevents material from piling under unit.

Thiele Kaolin Co., Sandersville, Georgia, supplies kaolin to coat paper for *Life* magazine and for quality papers from mills across the country. To get this kaolin, Thiele is working a 30-acre pit, using 2 draglines, a ¾-yd. shovel, and an 11-ton D Tournapull Rear-Dump.

At one end of the mine, a dragline with 6-cu. yd. bucket strips overburden. As the kaolin is exposed, the dragline digs this material and dumps it in stockpiles according to grade.

It is necessary that the various grades of kaolin be carefully blended to produce the final quality specified by the ultimate users. To accomplish this "mixing", a ¾-yard shovel loads "lean" kaolin into the D Tournapull Rear-Dump, which hauls it to other "rich" stockpiles near a mixing hopper. Here a second dragline mixes and loads the kaolin into the hopper. The material is mixed with water and forced by pressure-pump through a pipeline to the mill.

Averages 42 loads a day

At the time these photos were taken, the ¾-yard shovel was loading Tournapull Rear-Dump with approximately 7½ yards of kaolin in about 2¾ minutes. The average 500′ haul from the "lean" pile to dumping area was deeply-rutted, wet, and slippery. Although some of the ruts were 2′ deep, rig's haul-time averaged only 1½ min. It took Rear-Dump less than a minute to turn, back into position, and dump. Rig completed average 1000′ cycle in 6 min. 20 sec.... hauled 38 heaping loads in 6½ hours. Rig averaged 42 loads per 8-hour day, depending on mill requirements.

Replaced 2 trucks with 1 Rear-Dump

Originally, Thiele used 2 trucks, but replaced them with the one D Tournapull Rear-Dump. According to Supt. Owen E. Robbins, "One-man operation suits me! We like Rear-Dump's ability to get through mud where trucks couldn't go."

Power-transfer differential and power-steer, speed hauling

With Tournapull prime-mover's exclusive power-transfer differential, which automatically applies power to wheel on firmest footing, the heavily-rutted and slippery underfooting is no problem. Positive power-steer adds to Rear-Dump's tractive power, because it lets operator pivot prime-mover from side-to-side to "walk" machine out of tough going.

Increase production . . . cut costs

According to Mr. Robbins, a saving of 75% in fuel, and 50% in lubricating oil was effected when 2 trucks were replaced by one D Tournapull Rear-Dump. Changing from trucks to Tournapulls, Thiele Kaolin reduced operating costs and increased production. Rear-Dump provides uninterrupted service in these mining operations.

Looking for a way to save money?

If you have a hauling problem of any kind, investigate Tournapull Rear-Dumps... available in three sizes: 11, 22, and 35-ton capacities. Send for detailed information.

Tournapull—Trademark Reg. U.S.Pat. Off. DR-1062-M-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

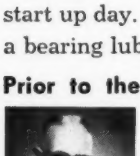
WHERE QUALITY IS A HABIT

STANOLITH Grease gives coal a smooth ride

Over 5,000 bearings need just one grease. Never a bearing lubrication failure.

Part of the coal for the Wabash River Generating Station operated by the Public Service Co. of Indiana near Terre Haute, comes directly from the Viking Coal Mine Processing Plant via a conveyor system. The system operates 365 days a year moving up to 4,800 tons of coal per day. STANOLITH Grease has been used to lubricate all bearings in the conveyor system since February 3, 1953, the start up day. In all that time there has never been a bearing lubrication failure.

Prior to the initial operation of the conveyor system, maintenance supervisors checked with Paul Manning, Standard Oil industrial lubrication specialist, about lubricating the new installation. Paul, they knew, has extensive experience (21 years) in handling lubrication problems of this kind. Working with plant management, Paul recommended STANOLITH Grease No. 42 for the job. STANOLITH Grease has fulfilled maximum expectations.



STANOLITH Grease is a smooth textured grease. It is made from highest quality oil, lithium soap and special additives. It resists water washing and water contamination. STANOLITH Grease works well in exposed, outdoor installations. It will not channel. It is chemically stable. It can be applied easily by hand, gun or pressure system.

Find out more about STANOLITH Grease. Talk to your Standard Oil industrial lubrication specialist. There is one near you in any of the 15 Midwest or Rocky Mountain states. Or write 910 South Michigan Avenue, Chicago 80, Illinois.

***Quick facts about* STANOLITH Grease**

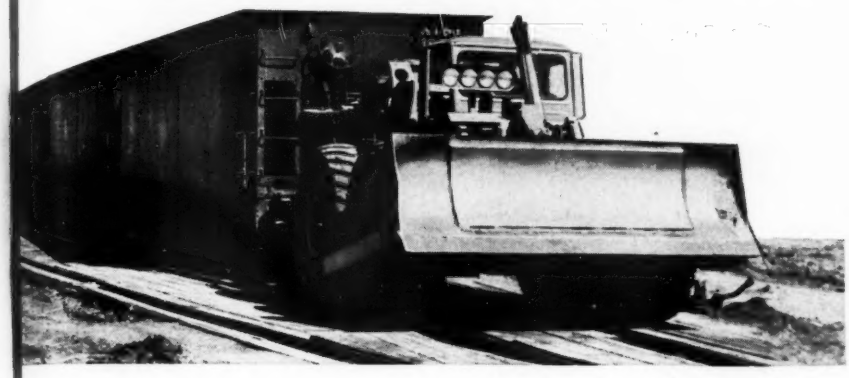
- Water resistant
- High temperature resistant
- Pumpable in grease gun or pressure system
- Mechanically stable

STANDARD

STANDARD OIL COMPANY
(Indiana)

Part of coal conveyor system at Wabash Power Plant, Terre Haute. Entire conveyor is lubricated with one grease —STANOLITH. No bearing failures experienced during the 3½ years conveyor has operated.

At desert uranium plant
versatile SwitchTractor
shunts ore cars, dozes, cleans-up



Amos Leach, right, general crusher foreman, points out sturdy construction of SwitchTractor coupler, left, to Operator Marion Roberts. Rubber-tired switcher pushes 18 empty ore cars, pulls 5 loaded cars up 1% grade.

Big 208 hp SwitchTractor moves strings of ore cars to siding at Anaconda uranium mill. Low-pressure tires won't damage tracks, ties, or switches. SwitchTractor takes most direct route to any job, isn't tied to tracks.

Here's the story how The Anaconda Company solved a problem of rail traffic handling — together with pit and plant clean-up — at its uranium works in New Mexico. Anaconda needed switching service for ore cars at both terminals of a 35 mi. rail-line connecting a mine near Laguna with a processing plant close to Grants. Both locations are in the desert west of Albuquerque.

A survey of probable switch-yard activity showed that car-shunting and spotting would be an intermittent job. If standard switch-engines or specialized rubber-tired switching vehicles were used, they would be idle much of the day. While these machines "mark time", costs mount.

Wanted: dual-purpose machine

The metals firm decided it needed a dual-purpose machine — a coupler-equipped tractor. One with the "beef" to push or pull strings of ore cars . . . to doze, and haul equipment wherever needed around pit and plant. It wanted a fast, mobile rig — one able to speed from one job to another at short notice.

Double-duty SwitchTractor handles switching, dozing

Anaconda solved the problem with two versatile LeTourneau-Westinghouse SwitchTractors — one for each work center. Both at mine and mill, rigs met all job requirements.

At the Grants mill, Anaconda's SwitchTractor spots ore cars in the plant yard, keeps stockpiles in shape, cleans-up debris, hauls and pushes other mobile equipment. A. J. Fitch, manager of the New Mexico operations, had this to say about SwitchTractor's mill work:

"Moves 1,000,000 lbs."

"The machine has proved to our satisfaction that it can move a train of 1 million gross pounds up a 1 per cent grade. Riding over rails and switches proved no handicap."

In terms of cars, this means that SwitchTractor moves 18 empty or 5 loaded carriers up the incline.

Amos Leach, general crusher foreman, put it this way: "This tractor is very handy. It gets around nicely . . . both on and over railroad tracks, ties, and switches."

On 3 special jobs

"Around the plant," he added, "it speeds clean-up work after construction jobs . . . also loosens up stockpiles of packed ore, making them easier to handle. It pushes other heavy machines on cold mornings, too, to get them started."

SwitchTractor can solve the car handling problem on *your* sidings too . . . save you money doubling as a heavy-duty, clean-up tool around pit and mill. Let us give you complete details on this go-anywhere, dual-purpose tractor.

If you already own a Tournatractor, it can be easily converted for car-switching work, simply by the addition of a car-coupler at the rear. Write or phone for details.

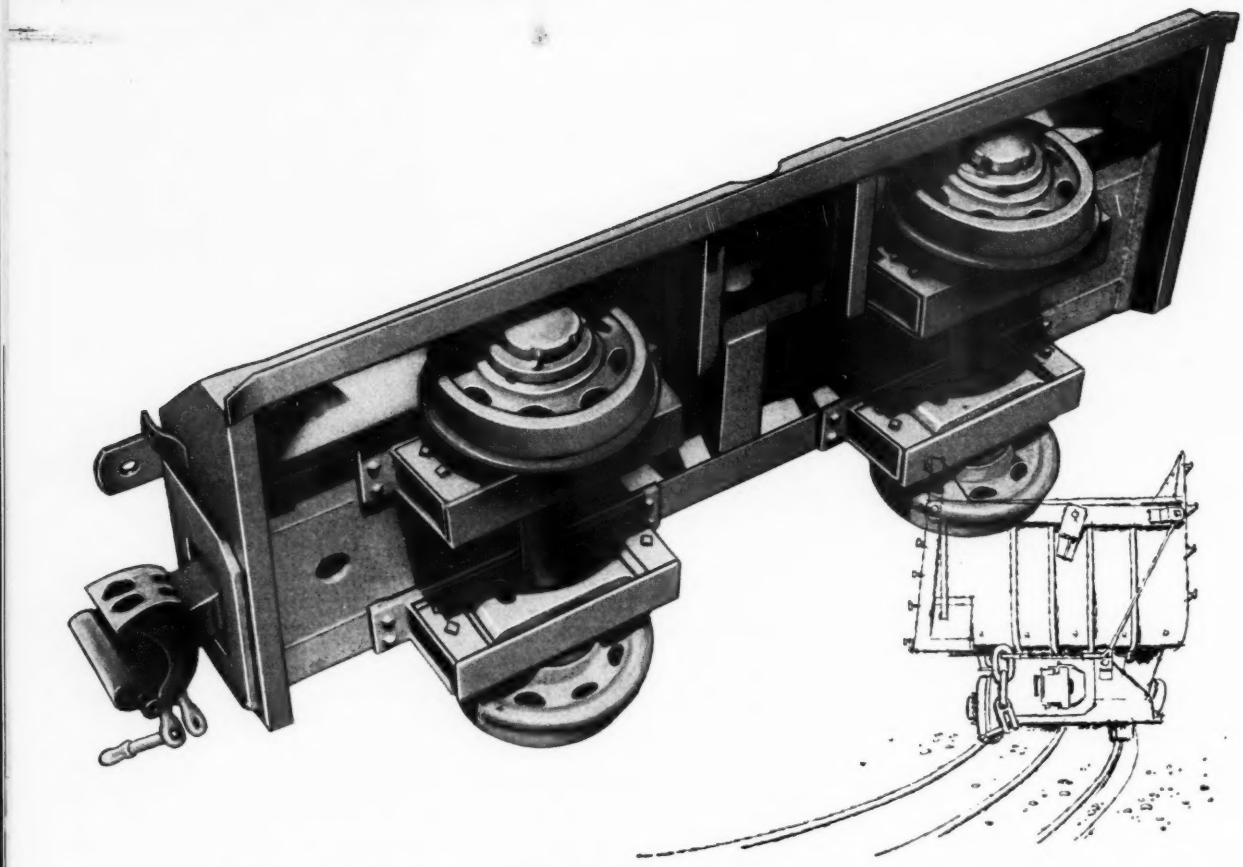
Rubber-tired tractor does all the work of a switch engine — yet costs much less to buy and operate. When not switching, rig keeps working as dozer at pit, plant or yard.

SwitchTractor—Trademark; Tournatractor—Trademark Reg. U.S. Pat. Off. ST-1072-M-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT



for extra strength
it's CRUCIBLE **MAX-EL** alloy steel

Mine car axles *always* take a beating. But where service is *especially* rugged, manufacturers – like C. S. Card Iron Works, Denver, Colorado – use Crucible Max-el 3½ alloy steel.

In their own words, here's why . . .

"We use Max-el 3½ because of its high-strength . . . good fatigue resistance . . . and over-all economy."

Good reasons why Max-el, or another of Crucible's wide range of special alloy steels, may be the right answer to many of your more exacting applications. Your local Crucible representative will be glad to give you more details.

Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

KENWORTH
802
24-TON

KENWORTH
802-B
48-TON

What do you need on your job? Kenworth has the custom-built end-dump for you—developed in cooperation with contractors and miners to haul rock and ore at lowest cost. Among the many Kenworth-engineered rock and ore movers are the 802 with its capacity of 19 cu. yds. heaped, and the 802-B with a trailer carrying a big 32 cu. yd. load. Both are built to haul tremendous loads over the roughest terrain where ordinary heavy-duty trucks wouldn't stand the going. Each has Kenworth's variable section frame, measuring 15½" at its deepest section. Front axle capacity is 25,000 lbs.—drive axle capacity, 70,000 lbs. Here are spring-mounted huskies easy to control, moving quickly and smoothly in and out of tight corners. Power steering installation is simple and rugged—brakes are oversized—visibility is unequalled. These are the trucks the men in the field asked for—proving again . . .

. . . There's more WORTH in KENWORTH

KENWORTH

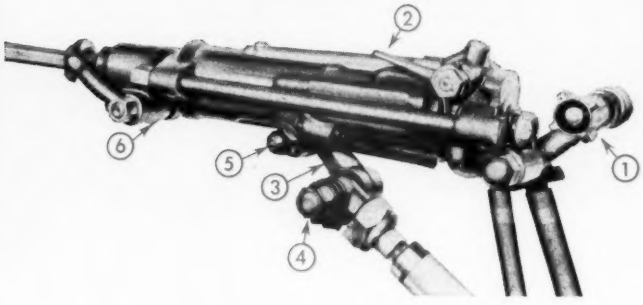
TRUCKS ★ BUSES

Ten Reasons Why the JR-38B

UNIVERSAL JACKDRILL

makes rock drilling a FASTER, EASIER one-man job

These Jackdrill features make the JR-38B the fastest-drilling, easiest-handling universal drilling unit ever developed



1 **Roll-Type Feed-Leg Valve,** built into handle, gives smoothly variable control from zero to full air pressure — can be reversed for right or left hand operation.

2 **Five Position Throttle** controls all functions — hole cleaning, shut-off, leg-feeding, hole collaring and drilling.

3 **Built-in Air Connection** between drill and feed leg eliminates third hose, simplifies setup and operation.

4 **Adjustable Tension** on hinge joint for easier handling.

5 **Adjustable Balance** shifts drill forward or backward to suit operator.

6 **Enclosed Steel Centralizer** has all working parts protected against dust and dirt.

7 **Constant Chuck Blowing** lubricates front end — keeps drill free of cuttings.

8 **One-Piece Chuck** with renewable recessed bushing — deflects air to side, protects operator against water splash.

9 **Rigid Construction** with fronthead recessed into deep counterbore. Built to stay on the job!

10 **Lighter Weight.** Telescopic feed leg weighs 10 lbs less than previous design. Much easier to handle.

CARSET JACKBIT IR

Longer-Lasting Carset Jackbits and the Faster-Drilling JR-38B JACKDRILL make an unbeatable drilling combination

THIS completely-integrated Jackleg Drill is designed to take full advantage of faster-drilling 1⅜" Carset Jackbits — saves air consumption, saves powder, cuts bit and steel costs too. Use it as a drifter, a stoper or a Jackhamer. Ask your I-R representative for complete information or send for Bulletin No. 4144-A.

Ingersoll-Rand

5-517 11 Broadway, New York 4, N.Y.

COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS • GAS AND DIESEL ENGINES

KEEP PRODUCTION ROLLING *with help like this . . .*

- **EXCLUSIVE "ROLL-AWAY" MOLDBOARD . . . moves tough dirt fast**
- **NEW TOGGLE-TYPE CONTROL . . . kick-free in the rough . . . pinpoint accuracy**
- **HIGHEST AXLE AND THROAT CLEARANCE in its class . . . for better handling of biggest loads**
- **TOUGH TUBULAR FRAME . . . shock-absorbing strength down the middle**
- **BOX-SEAT COMFORT AND VISIBILITY . . . satisfied operators . . . more and better work done on all grading jobs**

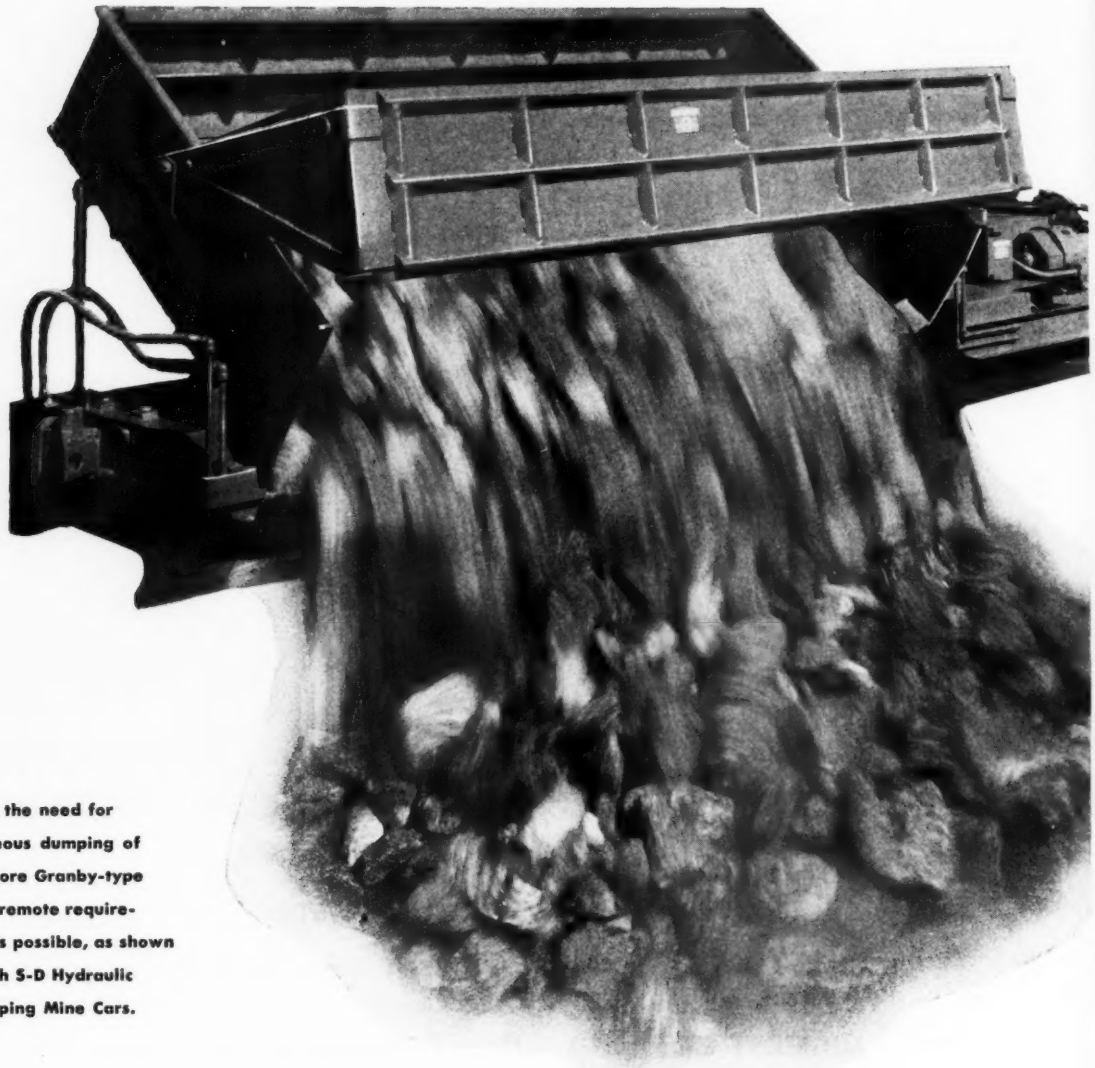
ROLL-AWAY is an Allis-Chalmers trademark

These are five of many reasons why Allis-Chalmers FORTY FIVE motor graders are showing up in more and more mining and quarrying operations. They are precisely what the dirt-moving specialists ordered . . . ready now to handle haul road construction and maintenance easily, smoothly. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

Another New Mine Car Development by Sanford-Day

S-D Hydraulic for dumping



Although the need for simultaneous dumping of two or more Granby-type cars is a remote requirement, it is possible, as shown here, with S-D Hydraulic Self-Dumping Mine Cars.

Is there something special you need in mine cars? You will probably find the answer in our plant

SANFORD-DAY

Knoxville, Tennessee

"SUPER MARKET FOR MINE CARS" — *all types* ★ PRECISION WHEELS ★ "BROWNIE" HOISTS, CAR RETARDERS, SPOTTERS, PUMPS AND OIL SPRAY SYSTEMS ★ GISMO SELF-LOADING TRANSPORT that loads *(mucks)* in development or production . . . transports . . . supports 2 to 5 jib mounted drills . . . back fills . . . moves boulder rocks . . . makes its own roadways and cleans up completely — a new method of hard rock mining offering a tremendous reduction in cost per ton!

Self-Dumping Car answers need any car in a trip anywhere!

No Fixed Dumping Point or Ramp Required!

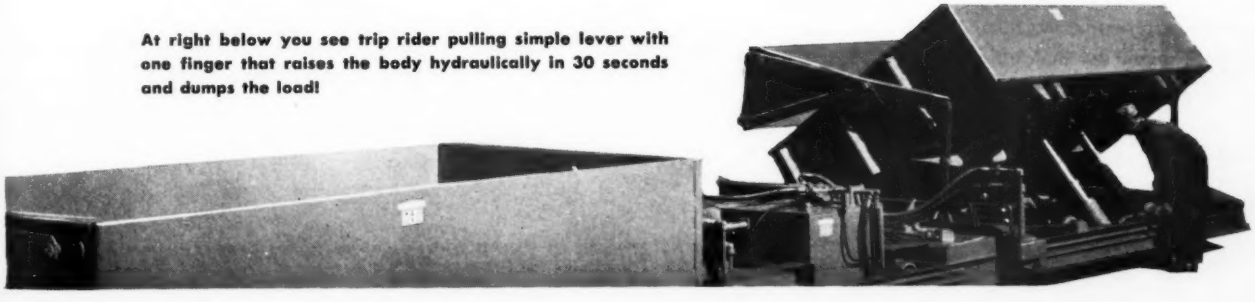
Twenty of these new cars were recently built for a large steel company to haul waste material out of mine development areas for disposal at outside ravines. The new S-D Hydraulic Self-Dumping Cars met the need for cars to operate in train and dump independently at any place. Of course, each car may be unloaded at the same fixed dumping point.

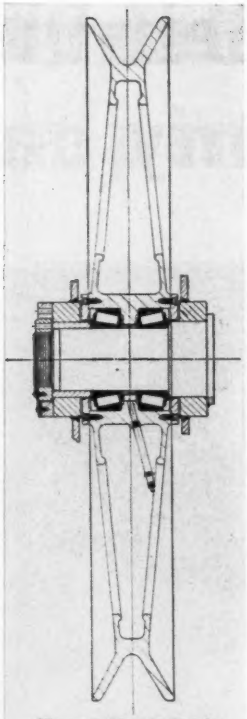
A pair of telescopic hydraulic cylinders raise the body to a dumping angle of 40 degrees. The trip rider selectively dumps each car by means of a lever located on side of underframe. Hydraulic power is supplied by a power unit mounted on a small car that is coupled in the trip. Hydraulic hoses connect the cars by means of quick-connect-and-disconnect self-sealing couplings. The car body raises or lowers in less than 30 seconds. Here is a car that could save you many man-hours and increase haulage efficiency if fixed dumping points are not practical or desirable. ***It is another example how cost-conscious mining men turn to Sanford-Day for the engineering know-how to help them successfully solve haulage problems.***

Each S-D Hydraulic Self-Dumping car pictured here has a 10-ton rock capacity, and is approximately 17 feet long, 7 feet wide and less than 4 feet high from top of rail.

Trip may be halted and each car dumped one-after-another, or, of course, trip moved on to each desired dumping point. Power unit car is normally located behind locomotive, although, as shown here, it may be coupled between cars.

At right below you see trip rider pulling simple lever with one finger that raises the body hydraulically in 30 seconds and dumps the load!





How **THE MARION POWER SHOVEL COMPANY** mounts sheaves on Timken bearings . . . to take radial, thrust loads in all combinations, keep heavy-duty sheaves in positive alignment.

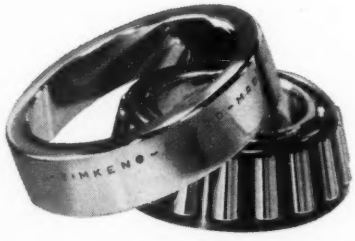
World's largest shovel scoops 90 tons, lifts it 10 stories moves it 290 feet on 34 TIMKEN® bearings

BUILT by the Marion Power Shovel Company, this gigantic "coal miner" moves many tons of overburden per hour for the Hanna Coal Company. With 10 motors controlling the digging cycle of the 90-ton capacity dipper—an additional 4 motors for its 8 powerful cat treads—built-in elevator—auxiliary crane for hoisting equipment aboard—this tremendous earth mover is 100 times larger than the ordinary construction shovel.

34 Timken® tapered roller bearings carry terrific radial and thrust loads in all combinations, at critical points—including swing machinery and all hoist sheaves. Full line contact between rollers and races gives extra load-carrying capacity. And because Timken bearings have case-carburized rollers and races—shock-resistant cores under hard, wear-resistant surfaces—they take heavy shock loads. Designed to roll true, precision manufactured to live up to their design, Timken bearings practically eliminate friction, reduce wear on integral parts. Closures are more effective, too, because Timken bearings keep housings and shafts concentric, keeping lubricant in, dirt, dust, water out.

When you buy or build machinery, look for the "TIMKEN" trade-mark on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

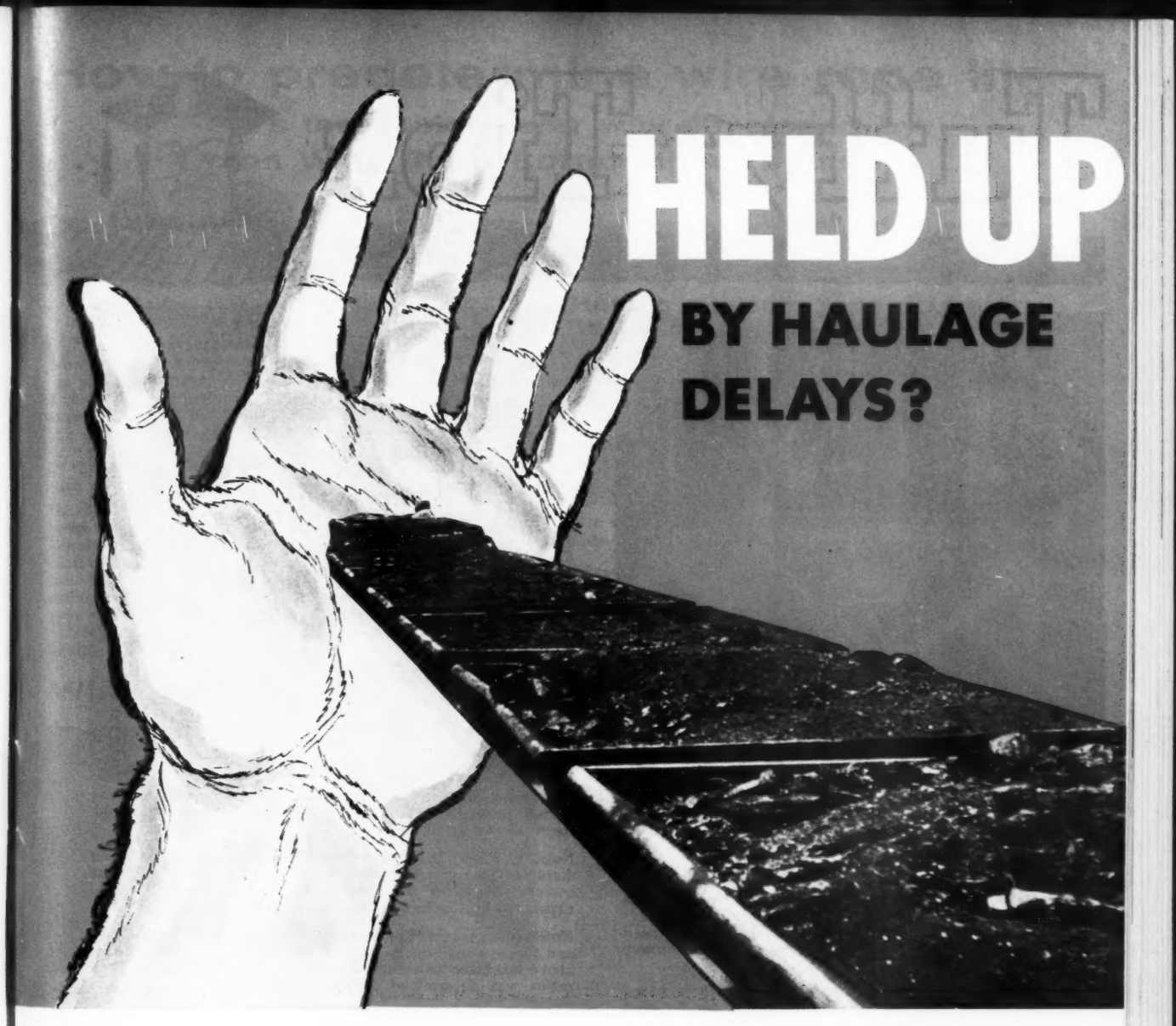
This symbol on a product means its bearings are the best.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD



Minimize Downtime with ACF Mine Cars

Ever stop production to repair your haulage system, losing money every minute of downtime?

Not if you have mine cars working for you. For mine car trips work full shift, every shift, without interruption. When one car needs repairs, you just shunt it aside... and the rest of the trip keeps rolling out the tonnage. Even when cars finally wear out after years of service, replacement involves just one car at a time, not a major overhaul. Because they minimize haulage delays, mine cars keep productivity up and cost-per-ton down.

And there are other advantages! *Flexibility:* as you advance the face, you merely add trackage without stopping the whole system. *Two-way payloads:* the cars that haul coal out carry men and supplies back in.

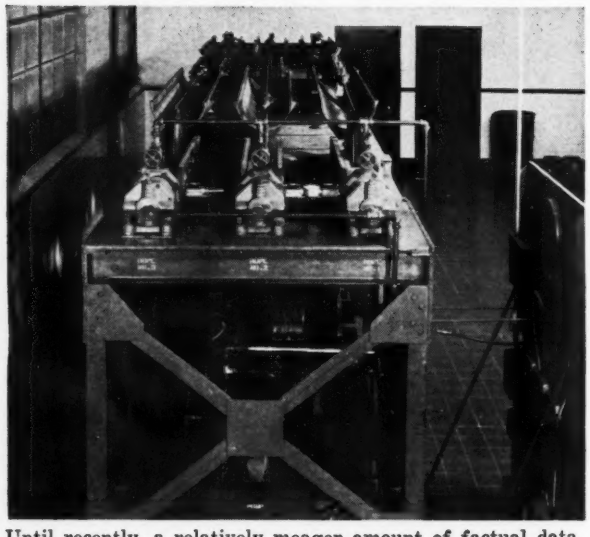
Actual figures, recorded by operators, show the many advantages of ACF Constant Haulage Mine Cars. Your ACF Representative can give you full information. Just contact any ACF office.

AMERICAN CAR AND FOUNDRY
Division of ACF Industries, Incorporated

Sales Offices: New York • Chicago • St. Louis • Cleveland Washington, D.C. • Philadelphia • San Francisco • Berwick, Pa. • Huntington, W. Va. *Plants:* Berwick, Pa. • Milton, Pa. St. Charles, Mo. • St. Louis, Mo. • Huntington, W. Va.

acf **MINE CARS** *for Constant Haulage*

Tuffy Wire Rope Tips



Until recently, a relatively meager amount of factual data has been available for estimating life expectancy of wire rope. Predicting how much service life could be expected from a given wire rope construction under a given set of operating conditions was largely a matter of guess-work, trial-and-error and generally inexact calculations.

Since bending stresses are a major factor in wire rope life, Union Wire Rope engineers designed the Accelerated Fatigue Tester, shown above, with which to pin down the effects of bending on wire rope. Now, from a long and exhaustive series of bending tests, scientific data has been accumulated and organized to take the place of former rule-of-thumb methods.

The data established by this laboratory research is based on the effect of various sheave diameters on bending stresses of various constructions of wire rope.

From test data, bending-life curves have been plotted by Union Wire Rope engineers for each of the more widely used rope constructions. Analysis made on each of these curves showed them to follow a pattern expressed by the curve shown in Fig. 1.

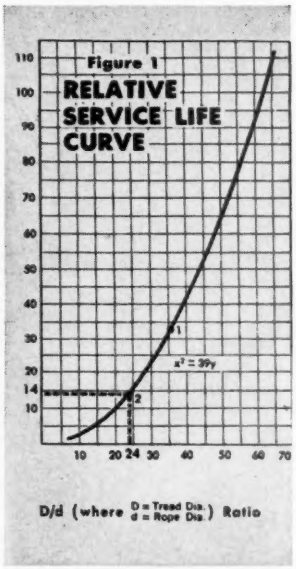


Table 2

BENDING-LIFE FACTORS

When Using Curve of 6x25 FW

CONSTRUCTION	FACTOR
6x7	0.57
18x7	0.67
6x17 Seale	0.73
6x19 Seale	0.80
6x21 Filler Wire	0.92
6x25 Filler Wire	1.00
6x31	1.00
8x19 Seale	1.14
6x37	1.33
8x19 Warrington	1.33
Tiller Rope	2.00

Table 3

SHEAVE DIAMETER FACTORS

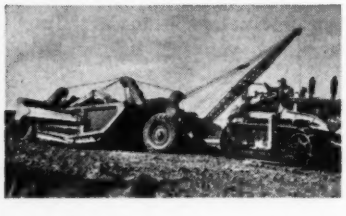
ROPE CONSTRUCTION	GENERAL PURPOSE RANGE D/d Ratios	Where D = Tread Dia. d = Rope Dia.
6x7	63	42
18x7	54	36
6x17 Seale	49	33
6x19 Seale	45	30
6x21 Filler Wire	39	26
6x25 Filler Wire	36	24
6x31	33	22
8x19 Seale	31	21
6x37	27	18
8x19 Warrington	27	18
Tiller Rope	18	12

Note on Fig. 1 the curve shows that as the ratio of tread diameter to rope diameter increases (see D/d figures at bottom of chart) the longer the relative service life as expressed by the figures at the left of the chart.

However, there are few pieces of equipment on which sheave and drum sizes can be large enough to afford D/d ratios above 50. From test data the general-purpose range of D/d ratios was determined. Those recommended are set up in Table 3.

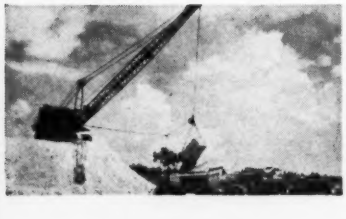
Spotted on the curve, for example, is the D/d ratio of 24 at point 1 and D/d ratio of 36 at point 2—these being the range for general purposes taken from Table 3 for the 6x25 filler

Tuffy Special Wire Ropes are tailored to special use. Ordering is easy:



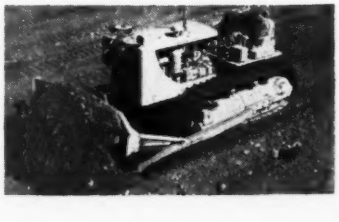
Tuffy Scraper Rope

Moves more yardage per foot because **Tuffy** Scraper Rope is specially built to take the beating of extreme drum-crushing abuse. Flexible; withstands sharp bending; hugs sheave grooves and winds snugly and smoothly on drums. High resistance to load shock on slack line.



Tuffy Dragline Rope

Longer-wearing line for all dragline operations. Special abrasion resisting construction which also gives extra flexibility. Tuffy Draglines also spool better, ride better on grooves and hold tightly to drums when casting. Consistently dependable in handling any material—wet or dry dirt, sand, gravel, rock, cement or minerals.



How to predetermine wire rope life

Here's the easier, surer way developed by Union Wire Rope Corporation Engineers

rope. Moving from these points to the left on the chart, the relative service life of this rope ranges from 14 to 34 units of any service measure used, such as yards, tons, days, etc.

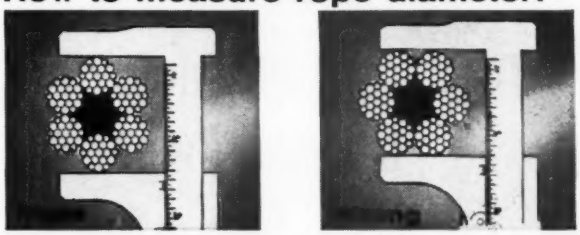
Now to determine the relative service life of say a 6x37. Its bending life factor (see Table 2) is 1.33 as compared to 1.00 for the 6x25 filler wire. Multiply the service life readings of 14 and 25 for the 6x25 filler wire by 1.33, and we find the service life range of the 6x37 falls at 18 and 27 units of service. Relative service life of other ropes are determined in the same way by using the bending factor indicated for each as the multiplier.

Of course bending is not the only wear factor in wire rope operation, and the general rule—that more flexible ropes should be used as bending stress increases with decrease in diameter of sheave or drum—has to be modified in field use. In fact there are eight other principal operating conditions, in addition to bending stresses, that affect wire rope service life. They are loading conditions, portability, corrosion, abrasion, rope speeds, materials handled, and equipment design.

What Size Rope?

Check groove diameter: When new wire rope is to be used on old equipment, make sure the tread or bearing surface of all sheaves is of sufficient groove diameter to avoid pinching the rope.

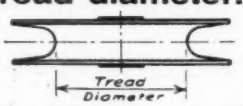
How to measure rope diameter:



Use a machinist's caliper. Be sure to measure the widest diameter.

How to measure tread diameter:

Select the smallest sheave or drum to be used with the new wire rope, and measure actual diameter of tread.



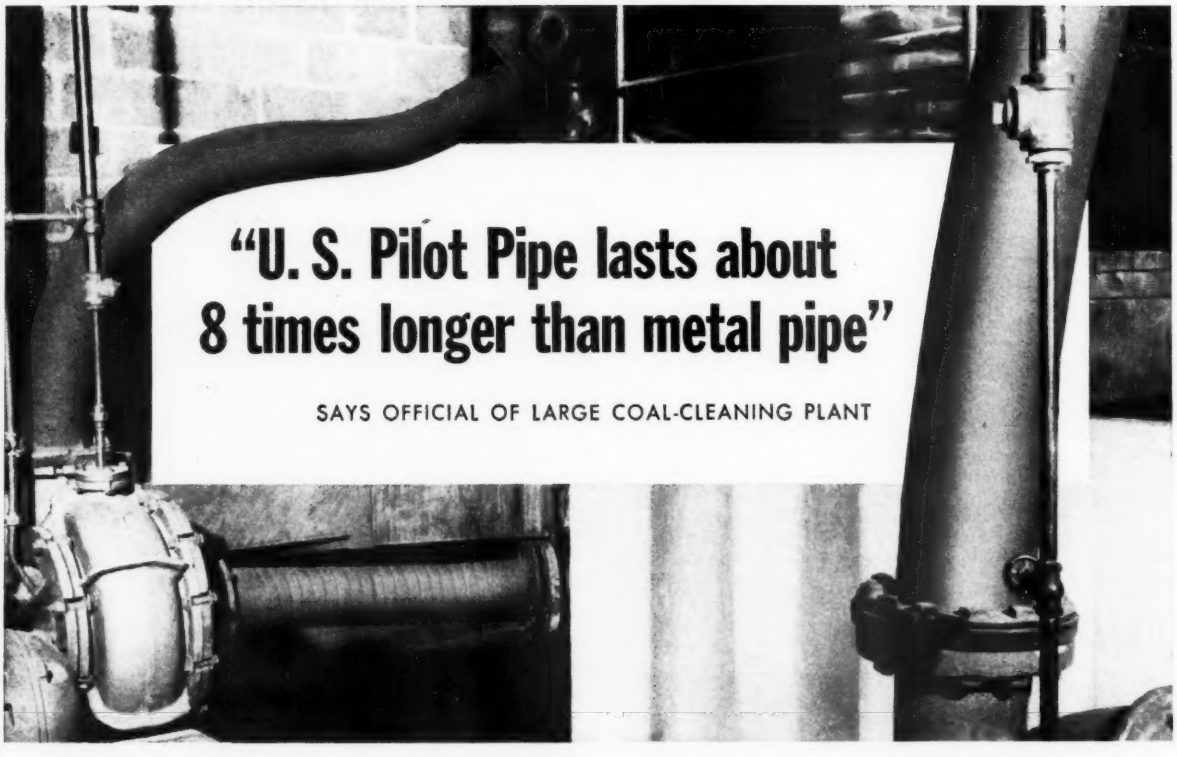
Sheaves with grooves corrugated with rope lay impression should be replaced with new ones before installing new wire rope.

New wire ropes are usually over-size. It is advisable to have groove diameters of sheaves or drums as large as the actual calipered diameter of the new rope, or slightly larger. We recommend sizes as follows:

Diameter of Rope	Groove Diameters	
	Minimum	Maximum
½" and smaller	diameter + 1/32"	diameter + 3/32"
9/16-1"	diameter + 1/16"	diameter + 1/8"
1-1/16-2"	diameter + 3/32"	diameter + 3/16"
Over 2"	diameter + 1/8"	diameter + 1/4"

Following the above instructions, you will know the Diameter of Wire Rope to use to fit your equipment.

US RUBBER PILOT PIPE



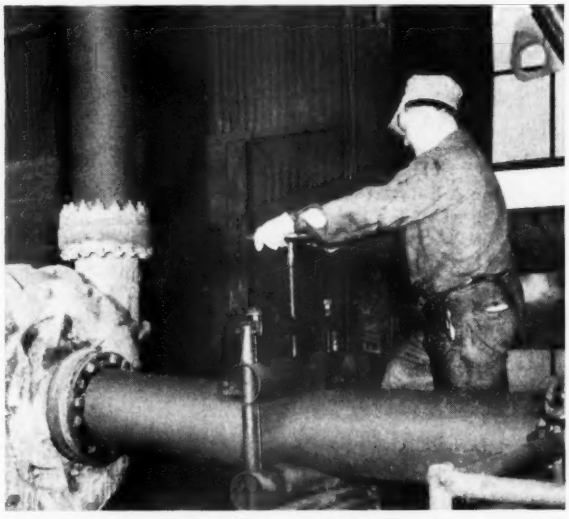
"U. S. Pilot Pipe lasts about 8 times longer than metal pipe"

SAYS OFFICIAL OF LARGE COAL-CLEANING PLANT

A large Eastern anthracite producer uses over 600 feet of U. S. Pilot Pipe to handle one of the most punishing jobs any pipe is ever called upon to do. This pipe is in the coal-cleaning plant where it has to circulate water containing solids (silt, sand, pyrite, refuse). These exert a severely abrasive action on the pipe. Yet, after 6 years of use, the U. S. Pilot® Pipe shows no sign of wear! Officials of the mine say U. S. Pilot Pipe *outwears metal pipe at least 8 to 1.*

U. S. Pilot Pipe is so flexible that no elbows or short connections are needed. Together with pinch valves it safeguards equipment from the mechanical strain caused by vibration, expansion, contraction and "water-hammer". Available at any of the 28 "U. S." District Sales Offices, or selected distributors, or write us at Rockefeller Center, New York 20, N. Y.

In Canada, Dominion Rubber Company, Ltd.



Closing valve on section of U. S. Pinch Valve Hose to control flow of abrasive water in preparation plant. Mechanism is compactly designed, can be refitted to new pinch valve bodies.

US RUBBER Mechanical Goods Division

United States Rubber

(Illustration from Agricola's De Re Metallica (1621)

All ore processing was difficult 400 years ago

There was a time when the grinding in an ore preparation plant consisted of a man with a hammer—like the one shown here, equipped with heavy leggings and gloves to protect himself against flying ore chips.

Today's ore processing plant is a far cry from this. It utilizes efficient grinding mills that turn out many tons of processed ore every day—mills which so often use CF&I Grinding Balls and Rods. CF&I Grinding Balls and Rods are always made from special analysis steel that has the ideal balance between toughness and hardness to assure optimum grinding ability and maximum wearability.

THE COLORADO FUEL AND IRON CORPORATION

Albuquerque • Amarillo • Billings • Boise • Butte • Casper • Denver • El Paso • Ft. Worth • Houston • Lincoln (Neb)
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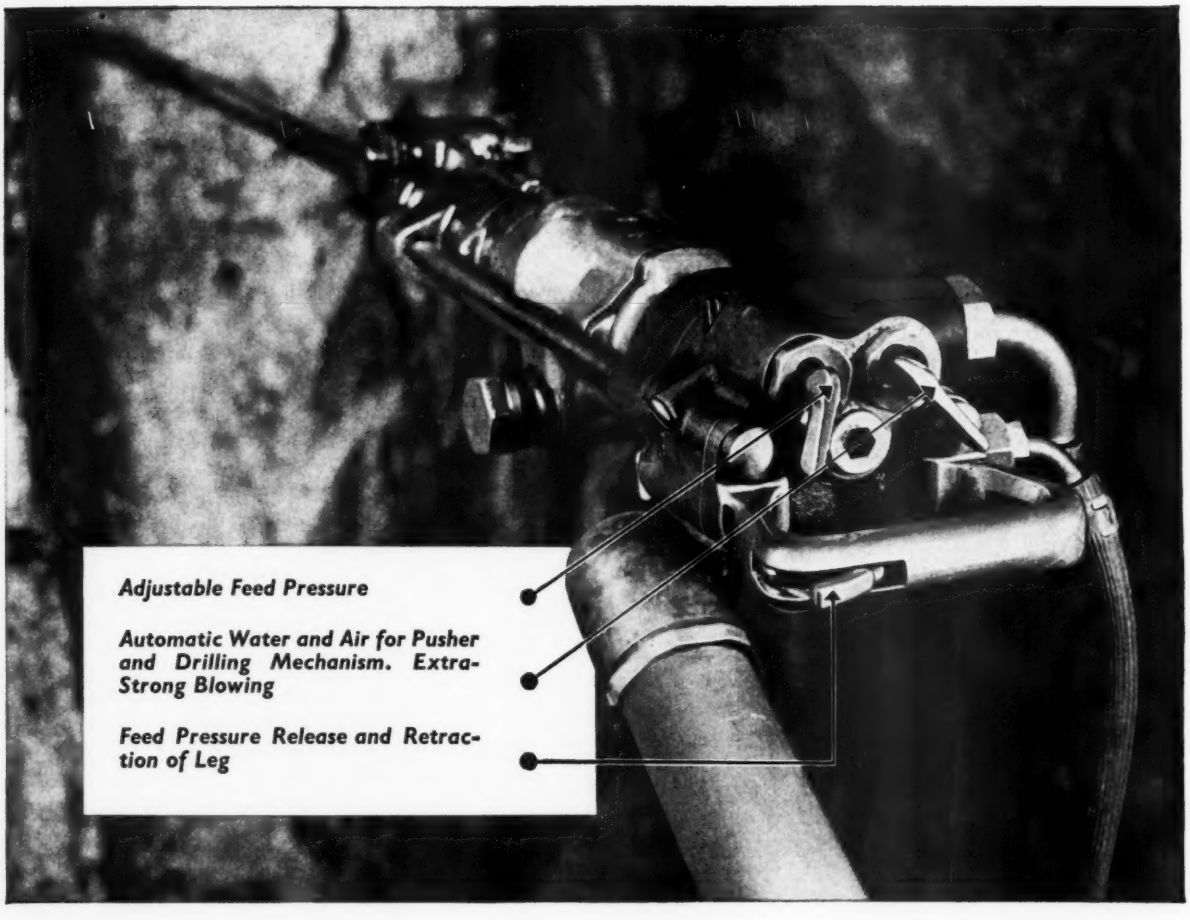
CF&I



RETRACTABLE LEG AND ONE-HAND GRIP-CONTROLS SPEED DRILLING TIME

For years Atlas Copco have been the world's largest manufacturers of pusher leg drills. Since 1937 when Atlas Copco, far ahead of any other manufacturer, introduced their first pusher leg drills, they have continuously improved the design of these drills. Their latest development, the Atlas Copco 'Lion', combines an unequalled ease of operation together with a high drilling rate—both contributing to a higher footage per manshift.

All controls under one hand

The Atlas Copco Lion is the first drill to have all the valves which operate the drill under the control of one hand. *Full control without having to move the hand from the backhead!*

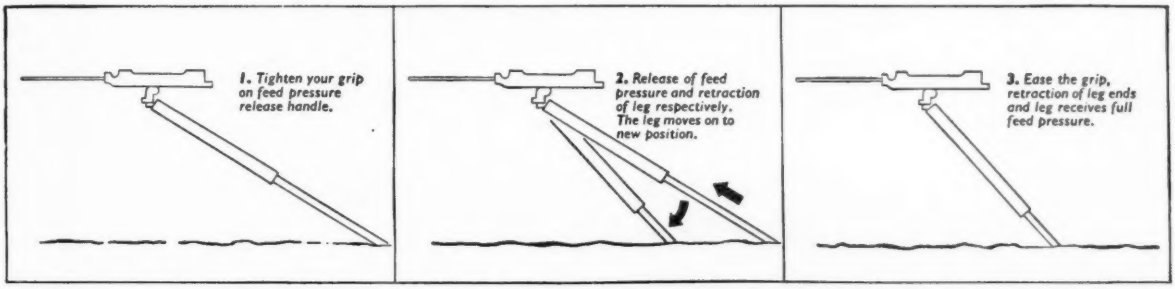
The valves are all easy to operate. By the use of only the fingertips the drill can be started or shut off, the feed can be adjusted to the pressure required, or retracted for an advance, and the extra air-blowing can be brought on to clean the holes.

All the control handles have been designed in such a way that they are well protected. While using them the operator's hand is never near the wall or roof of the drift. The Lion is the first pusher leg drill with controls placed for drifting.

Retractable leg saves time

When the leg has to be moved the feed pressure is easily released by squeezing the hand grip. By further pressure on the grip the leg retracts automatically.

Pusher leg moves forward with drill in full action



When the leg is in the new position suitable for continuous drilling, retraction stops and the feed pressure comes back by loosening the grip of the hand. *All this can be done while the drill is still running.*

This new idea of a retractable leg enables quicker repositioning of the leg and reduces the number of steel changes, thereby increasing footage per manshift. When drilling high holes it is now far easier to alter the position of the leg more frequently in order to maintain an optimal feed angle and feed pressure.

Packed with power for deep holes

The Lion has a drilling rate at least 30% higher than other rock drills of the same weight. Furthermore, it is designed so that it can maintain its high speed *even when drilling deep holes.* This means quickly drilled deep hole rounds and a faster, steadier advance. You'll also find that the Lion reduces *to a minimum* the gauge wear of the bits in abrasive rock. And owing to the ease with which the feed pressure is released and brought back into action, the Lion is a *handier* drill to work with in fissured rock.

Sandvik Coromant—the right steel for the Lion

All Atlas Copco drills—and this goes for the Lion—have been developed from the earliest stages with Sandvik Coromant tungsten-carbide-tipped integral steels and detachable bits. No drill or steel developed separately could ever give such equivalently high performances as this drilling combination. It is today the most widely used in the world, responsible for drilling more than one billion feet per year.

Free Demonstration! *Wire, 'phone or write* today *to any one of these offices and see the Atlas Copco Lion in action for yourself.*

U.S., Atlas Copco Pacific, Inc., 930 Brittan Avenue, San Carlos, California. Atlas Copco Eastern, Inc, P.O. Box 2568, Paterson 25, N.J.

CANADA, Atlas Copco Canada Ltd., Montreal Airport, P.Q.

MEXICO, Atlas Copco Mexicana S.A., Apartado 56, Torreon, Coahuila.

The ATLAS COPCO GROUP puts compressed air to work for the world. It is the largest group of companies specializing solely in the development and manufacture of compressed air equipment. It embraces Atlas Copco companies or agents manufacturing or selling and servicing Atlas Copco equipment in ninety countries throughout the world.

Without changing the grip of the hand the driller can easily position and control the machine, saving time and reducing fatigue.

Atlas Copco DS51

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment

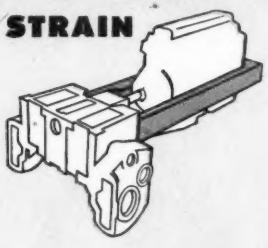
ALLIS-CHALMERS HD-21

Engineered to take the STRAIN, the SHOCK, and the GRIND of tough dozing jobs

HD-21

Approx. Weight (as illustrated) with hydraulic angledozer
51,845 lb
204 net engine hp

THE STRAIN

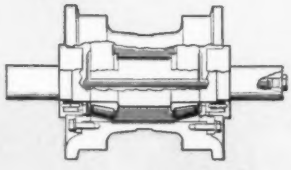


Frame-twisting stresses prove the value of the Allis-Chalmers all-steel, Box-A Main Frame. It is strong and flexible . . . soaks up strains. It is a complete unit . . . does *not* use the engine as a structural member. It allows more efficient equipment mounting, provides excellent weight distribution and makes possible unit construction for unmatched servicing ease.

THE SHOCK

Sudden overloads are common in dozer operations. But hydraulic torque converter drive cushions the shock and protects the entire power train. This drive is standard equipment on the HD-21 and has been *proved* on Allis-Chalmers tractors since 1941.

THE GRIND



Sometimes tracks churn all day in fine, abrasive stone . . . could be a serious threat to final drives, idlers, truck wheels and support roller bearings. But this "grinding compound" never reaches the bearings on an Allis-Chalmers tractor. Exclusive design features make it possible to use tapered roller bearings with *Positive* Seals that keep dirt and moisture out and hold lubrication in for at least 1,000 hours.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

Get all the facts from your Allis-Chalmers dealer . . . now!

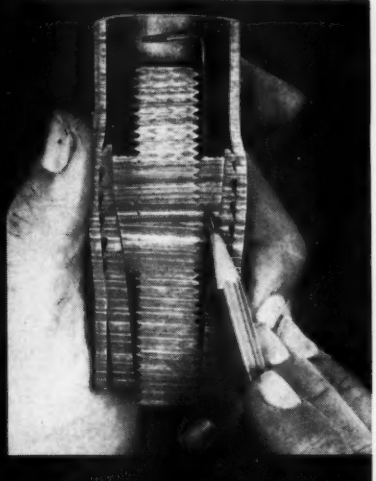
ALLIS-CHALMERS

Here's what to look for in a Shell and Plug...

1 Two-piece shell of O-B Bail-Type flexes easily, doesn't resist expansion forces created by bolt tension. Result is a quick-setting unit with more useful expansion force per ft. lb. of torque.

2 Three-step taper in O-B plug is designed to take up the slack in the bolt hole fast, develop a powerful "socket" anchorage, prevent high unit stresses at extreme top edge of plug.

3 Horizontal section of expanded O-B unit shows four-way expansion of shell fingers. Four-way distribution of stress permits high loading without distorting plug or pinching bolt threads.



4 Vertical section of expanded O-B unit shows solid "stack-up" of metal in bolt, shell, and plug. This solid metal contributes to superior strength of the socket formed by the plug.

5 Sectioned pieces of expanded O-B unit show heaviest markings in middle or "socket" area of plug. Lighter markings at top of plug prove excellent stress distribution at point of greatest expansion.

6 Section of steel pipe in which O-B unit was expanded for test shows that expansion forces are distributed evenly over all four shell fingers. Serrations on shell fingers make clean sharp impressions.

and here's the place to find it →

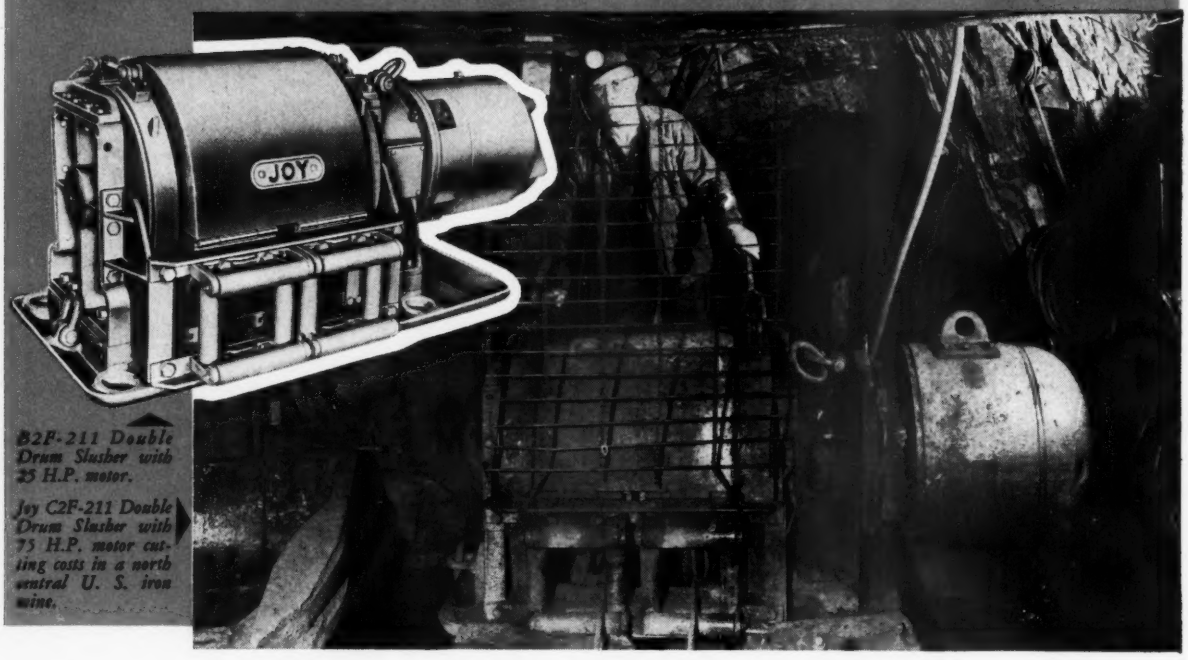
OHIO BRASS COMPANY • MANSFIELD, OHIO

In Canada: Canadian Ohio Brass Co. Ltd., Niagara Falls, Ont.

O B

SHELLS AND PLUGS

HAUL ORE AND ROCK AT LOWEST COST WITH JOY A-B-C Slushers



B2F-211 Double Drum Slusher with 25 H.P. motor.

Joy C2F-211 Double Drum Slusher with 75 H.P. motor cutting costs in a north central U. S. iron mine.

The A-B-C's of low cost scraping are not learned in school—you learn them in the field. Joy A-B-C slushers, A2F, B2F, and C2F, two and three drum, have demonstrated, in mine after mine, their ability to haul at rock bottom cost. It's not hard to learn why.

Joy A-B-C slushers operate at lower cost because clutches are bigger and wider for longer life—for longer intervals between adjustment and relining. Rugged construction with one-piece rigid base keeps all working parts in perfect alignment. Large drum diameters give longer rope life. A-B-C slushers reduce operator fatigue because their clutches are 100% self-energizing.

For simple, low-cost maintenance Joy A-B-C slushers have only one grease fitting per drum . . . to service each drum's planetary gear train. Grease reservoirs adjacent to shielded type ball bearings provide lubrication as needed. Clutch bands and adjusting nuts are out in the open, easily accessible for adjustment and relining.

These are just some of the cost saving features built into the Joy A-B-C line. They are available with flange mounted electric or air motors from 10 to 75 H.P.

Why not find out more about the A-B-C's? Write to Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

WSW-M-6244-121

Write for FREE Bulletin 121-3

Consult a Joy Engineer

for AIR COMPRESSORS, ROCK DRILLS, CORE DRILLS, HOISTS and SLUSHERS, MINE FANS AND BLOWERS

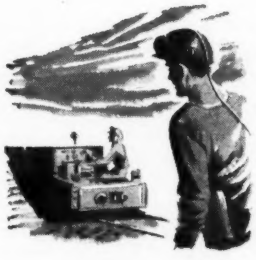
JOY

WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING EQUIPMENT

Being interviewed is H. A. Fuggiti, Acting Senior Development Engineer

"Here's where the heavy slugs of power come from"

At the Exide Laboratories—**Reporter:** Just exactly what part of the battery is that, Mr. Fuggiti?



Fuggiti: This is the Exide-Ironclad positive plate. And in any battery, power reserve is governed by positive plate area.

Reporter: Then do you mean that Exide-Ironclad Batteries have *more* positive plate area?

Fuggiti: Exactly. You can see that here. The cylindrical power tubes are arranged in a row. So the semicircular sides give an effective plate area one-third more than the plate size.

Reporter: How does that increase power reserve?

Fuggiti: Because there's a bigger working surface of battery plate exposed to the electrolyte. Power response is faster.

Reporter: What does this mean in battery performance?

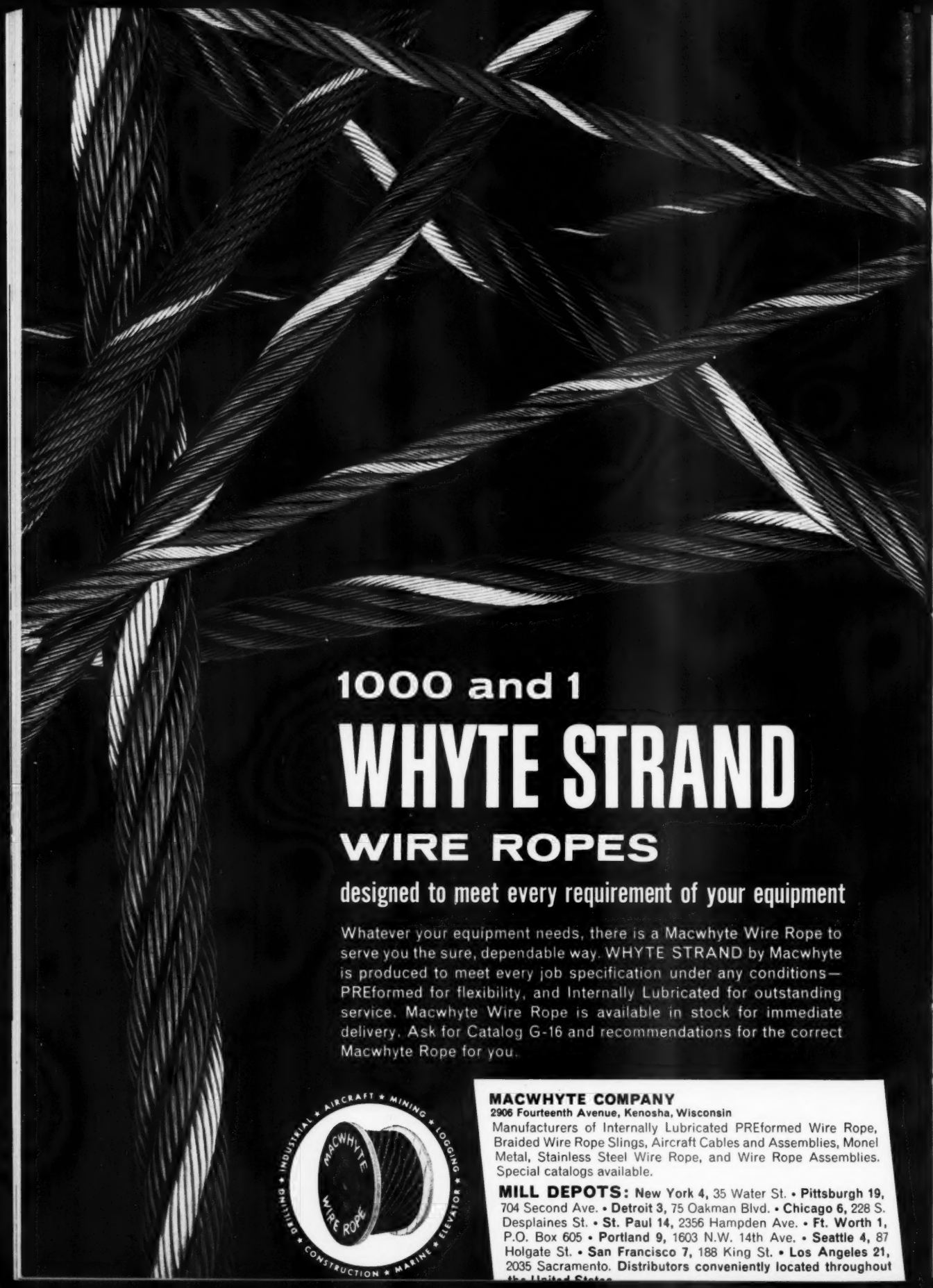
Fuggiti: It means the battery can provide power to spare for peak power loads as well as a dependable source for continuous loads.

Reporter: Obviously this is an important feature of the Exide-Ironclad Batteries.

Fuggiti: Yes it is, but it's just one of many engineering details that contribute to their long life and high capacity.

Note to battery users: Whenever you order heavy duty batteries or the equipment that requires them, be sure to specify Exide-Ironclad. For detailed bulletin, write Exide Industrial Division, The Electric Storage Battery Co., Philadelphia 2, Pa.

THE ELECTRIC STORAGE BATTERY COMPANY Exide®



1000 and 1

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WIRE ROPES

designed to meet every requirement of your equipment

Whatever your equipment needs, there is a Macwhyte Wire Rope to serve you the sure, dependable way. WHYTE STRAND by Macwhyte is produced to meet every job specification under any conditions—PREformed for flexibility, and Internally Lubricated for outstanding service. Macwhyte Wire Rope is available in stock for immediate delivery. Ask for Catalog G-16 and recommendations for the correct Macwhyte Rope for you.

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Manufacturers of Internally Lubricated PREformed Wire Rope, Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal, Stainless Steel Wire Rope, and Wire Rope Assemblies. Special catalogs available.

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Most mines can Roof Bolt

Effectively and Profitably ....

WHILE each mine may be different in physical characteristics, in method of operation or types of equipment used—all mines have one problem in common—the problem of keeping the roof in place.

Hundreds of mines, with all different kinds of roofs, have proved that roof bolting is the best form of roof control. They have also found that bolting leads to increased safety, better ventilation and greater production efficiency. Roof bolting offers so many profitable production advantages it justifies any mine, now using conventional timbering methods, making comparative roof support tests. Bolting tests can be made at very little cost.

To be as effective as possible—roof bolting calls for thorough knowledge of the roof strata—well planned bolting patterns and cycles—proper selection of bolts and shells—and adequate supply and service program. Being "The Pioneer in Roof Bolting" —PATTIN MFG. COMPANY, staffed with experienced roof bolting, mining engineers, is capable of meeting every requirement for quality products and service. Your phone call or letter will get immediate attention.

Shown above is the outstanding PATTIN style D-1 expansion shell. Samples of the "D-1" or "D-2" shells will be furnished upon request.

In Western States

PATTIN expansion shells are available and serviced exclusively through Colorado Fuel and Iron Corporation, Denver, Colorado. Western mining companies may contact them direct for information and consultation.

PATTIN MANUFACTURING COMPANY

"69th Year" MARIETTA, OHIO

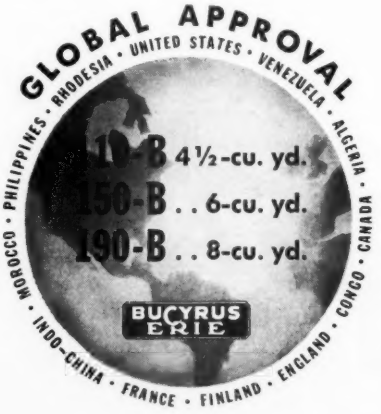
In California...and the World Over
Bucyrus-Eries Live Up to Reputation for High Output

Bucyrus-Erie 6-yd. 150-B shovel working at Eagle Mountain mine. Ore bearing formations here are high in iron content and considerably heavier than most rock.

Miners the world over have learned to expect outstanding performance from Bucyrus-Erie Ward Leonard electric shovels — and they get it, no matter how tough the assignment.

The machine above, for instance, is on a California project where it handles massive, heavy iron ore and waste rock — an extremely hard, fine rock which is quite abrasive. It's a true test of an excavator's strength and durability but here, as on other tough jobs the world over, the Bucyrus-Erie shovel moves big yardages economically — day after day, month after month.

It's the *extra margin of quality,* both in design and manufacture, that qualifies Bucyrus-Erie Ward Leonard electric shovels for world-wide acceptance — and lets them live up to it. We would like the opportunity of explaining that extra margin of quality — and what it can mean in performance on your job. 96L56



BUCYRUS-ERIE COMPANY

SOUTH MILWAUKEE, WISCONSIN

Wet iron ore moves smoothly and quickly in this mine where two Goodman Rope Belts have been installed in sub-levels.

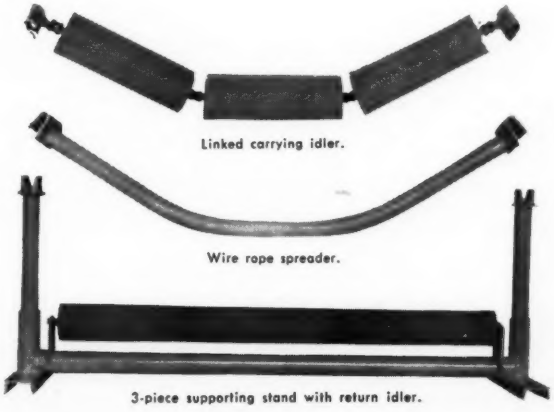
The Goodman *Rope Belt** Conveyor

for metal mine haulage . . . *COSTS LESS TO BUY . . . LESS TO INSTALL*

. . . HAS HIGHER CARRYING CAPACITY . . . NEGLIGIBLE SPILLAGE

It's easy to see why initial cost is low. With parallel wire ropes taking place of the usual rigid framing, the saving in the cost of intermediate sections is obvious. Accurate mine records show savings as great as 50%.

The same thing applies to installation and extension. There are no heavy structural units. Parts are few, simple, easy to handle. This is an important advantage where space is limited. Records show savings of many hours in installation and extension time.



Linked carrying idler.

Wire rope spreader.

3-piece supporting stand with return idler.

No tools are needed to add these parts to conveyor line. There is no framing that requires positioning for hooking or bolting together.

Carrying capacity of the Goodman Rope Belt is unsurpassed. The combined "give" of the tensioned, wire ropes and the linked idler assemblies cups the belt to the load, provides low impact shock at loading points and smooth travel along the line. This means less wear and tear on belt and idlers. And it also means that spillage, with attendant clean-up time, is practically eliminated.

Very important, too, is the adaptability of the Rope Belt to uneven bottom without the need of costly cribbing or supports. And the return belt is fully visible, easily accessible.

The Goodman Rope Belt is practical anywhere in a metal mine for any type of service. It saves time and money. It's the most useful conveyor you can buy.

Ask for full details. There's no obligation.

*Trade Mark

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CUTTING MACHINES • CONVEYORS • LOADERS

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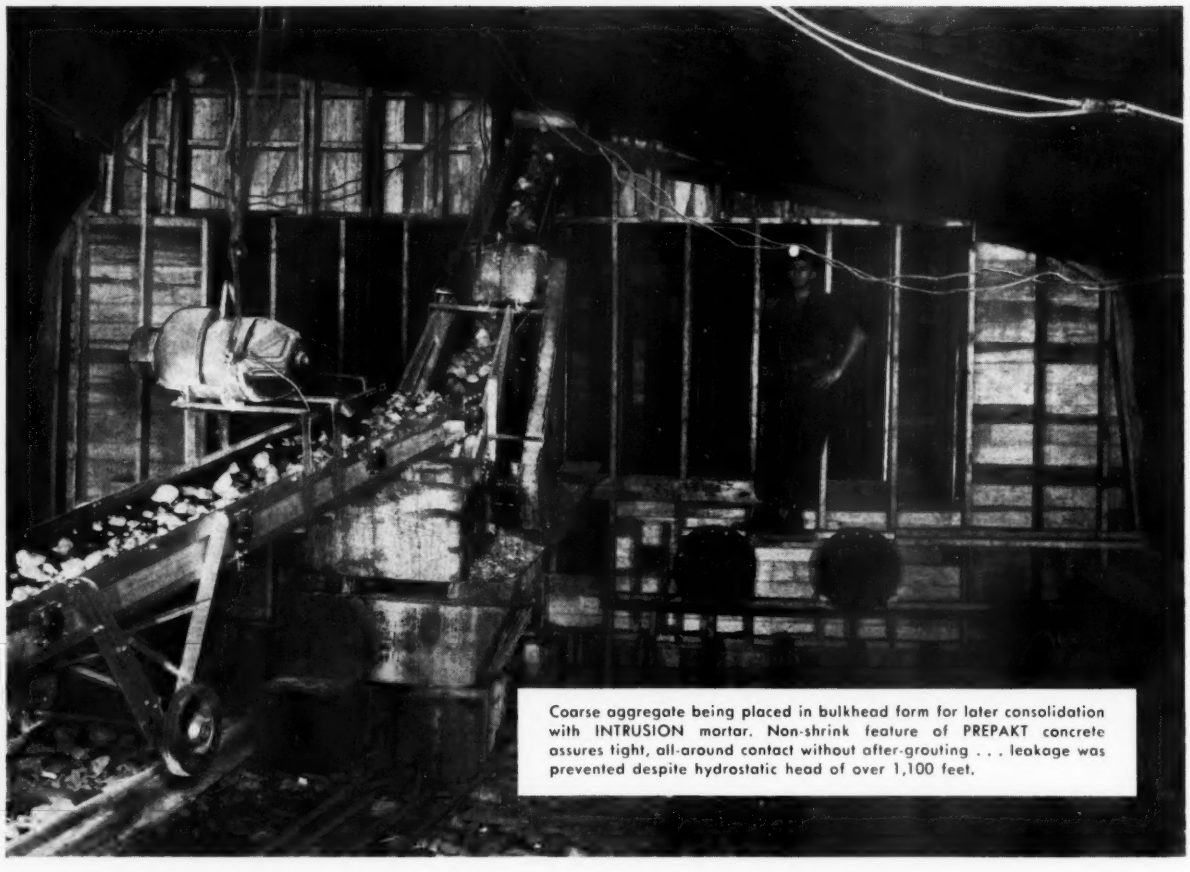


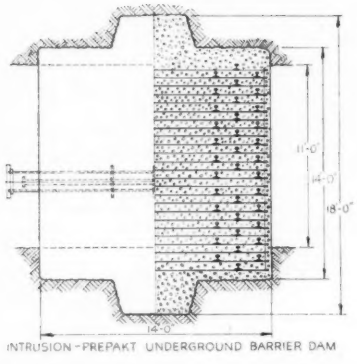
Coarse aggregate being placed in bulkhead form for later consolidation with INTRUSION mortar. Non-shrink feature of PREPAKT concrete assures tight, all-around contact without after-grouting . . . leakage was prevented despite hydrostatic head of over 1,100 feet.

Prepakt plugs off underground water

Underground flooding from abandoned drifts was halted by seven mine plugs of high-strength PREPAKT concrete at the Wenonah Mines of Tennessee Coal & Iron Division, U. S. Steel Corporation. Made "in the form" by economical consolidation of preplaced aggregate with INTRUSION mortar, these plugs are a seal against ground water with hydrostatic heads ranging from 855 to 1,150 feet.

PREPAKT concrete has no setting shrinkage and a low temperature rise so that a tight bond with the complete tunnel periphery results. Measuring 28′ wide x 14′ high x 14′ thick, each unit was keyed and reinforced. Access holes which can be quickly closed have been left where desired.

This project is another example of PREPAKT's ease and economy of operation. Why not investigate INTRUSION-PREPAKT methods and materials for your next concrete job? For information, contact: INTRUSION-PREPAKT, INC., Room 568, Union Commerce Bldg., Cleveland 14, Ohio. In Canada: INTRUSION-PREPAKT, LTD., 159 Bay St., Toronto, Ontario.



INTRUSION-PREPAKT UNDERGROUND BARRIER DAM

Cross-section of 200-cu. yd. Intrusion-Prepakt mine plug which is keyed to drift surface and reinforced with salvaged car rails.

If you would like a copy of a technical bulletin, "Mine Water Controlled by Intrusion-Prepakt", please send a request on your letterhead.

INTRUSION-PREPAKT, INC.

OFFICES IN PRINCIPAL U. S. AND FOREIGN CITIES

Intrusion and Prepakt are trade marks of Intrusion-Prepakt, Inc., whose methods and materials are covered by U. S. Patents Nos. 2313110, 2655004, 2434302 and others, also patents pending.

You get more Work-ability with "Eucs" in Mines and Quarries

Rear-Dump "Eucs" fit any operation . . . 10, 15, 22, 34 and 50 ton capacities.

Rear-Dump Euclids are built for long life on the toughest jobs. Their simple, rugged construction pays off in less down time for servicing and repairs . . . more work-ability day after day . . . as proved on hundreds of mine, quarry and industrial operations for over twenty years.

There are 5 models with rated payload capacities of 10, 15, 22, 34 and 50 tons. Engines from 128 to a total of 600 h.p. . . . top speeds with full payload up to 36 m.p.h. . . . 5 and 10 speed standard transmission or Torq-matic Drive . . . semi-rigid or spring mounted drive axle . . . standard or quarry type bodies.

Compare Rear-Dump Euclid performance with your present equipment before you replace or add to your hauling fleet. Your Euclid dealer has helpful facts and figures that show how "Eucs" can cut mine and quarry hauling costs and why ***Euclids are your best investment.***

EUCLID DIVISION, GENERAL MOTORS, Cleveland 17, Ohio

Euclid Equipment

FOR MOVING EARTH, ROCK, COAL AND ORE

Lower your costs with V-R BITS

ROOF BITS—Style DR—with an exclusive V-R carbide. Outperforms any other roof bit model. Try it and see.

LONG SHANK CUTTER BIT—Style L-1. Designed specifically for latest style miners. Cuts faster with less drag. Designed for solid mounting with longer life.

IMPROVED DESIGN CHAIN BIT—Style CM—for continuous miners. The flange seats tightly against the lug, prevents wobbling, minimizes carbide breakage. No other bit can beat it!

NEW ROTARY MINER BIT—Style CML-3—best bit yet for rotary style miners. Cuts faster with greatly reduced pressure. Free cutting action due to special bit design—reduces bit cost per ton.

AUGER BITS for Your Local Conditions.

Style D—available in two carbide grades, one for hard formations, one for abrasive.

Style DS—for hard, rough cutting.

Style DL—for non-coring coal.

AUGER MINER BITS—two gauges to suit local requirements. Heavy gauge prevents packing of cuttings.

FINGER BITS—Style FB—for all machines. Highly wear resistant carbide . . . V-R precision brazing keeps tip in place.

Here are the reasons why more and more mines are finding that V-R Bits are their best buy:

Sold and Serviced by Mining Men—your V-R representative is a mining man. His years of experience will help you get the right bit for the job . . . will help you use it to your best advantage.

Exclusive V-R Carbides—a bit is no better than its carbide. V-R has pioneered the development and manufacture of carbides since 1932. Over 23 years of specialized experience in this field.

Local Stocks . . . Local Service—in most major mining centers. V-R offers fast delivery so you can carry less inventory. And, you'll get prompt local V-R service.

Buy the bits that are best of all. Write for literature.

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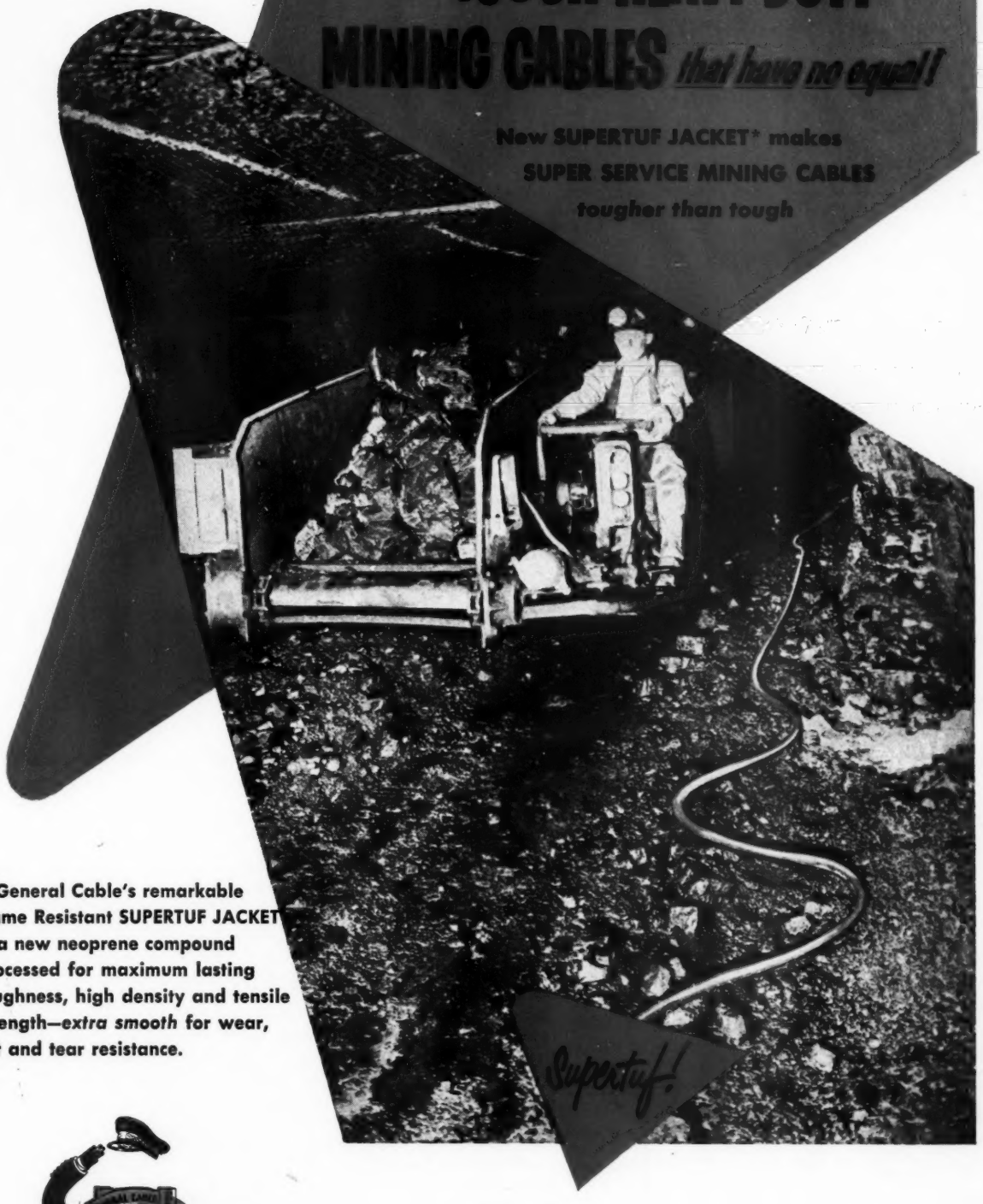
New SUPERTUF JACKET* makes SUPER SERVICE MINING CABLES *tougher than tough*



***General Cable's remarkable Flame Resistant SUPERTUF JACKET is a new neoprene compound processed for maximum lasting toughness, high density and tensile strength—*extra smooth* for wear, cut and tear resistance.**

General Cable... *at your service!*

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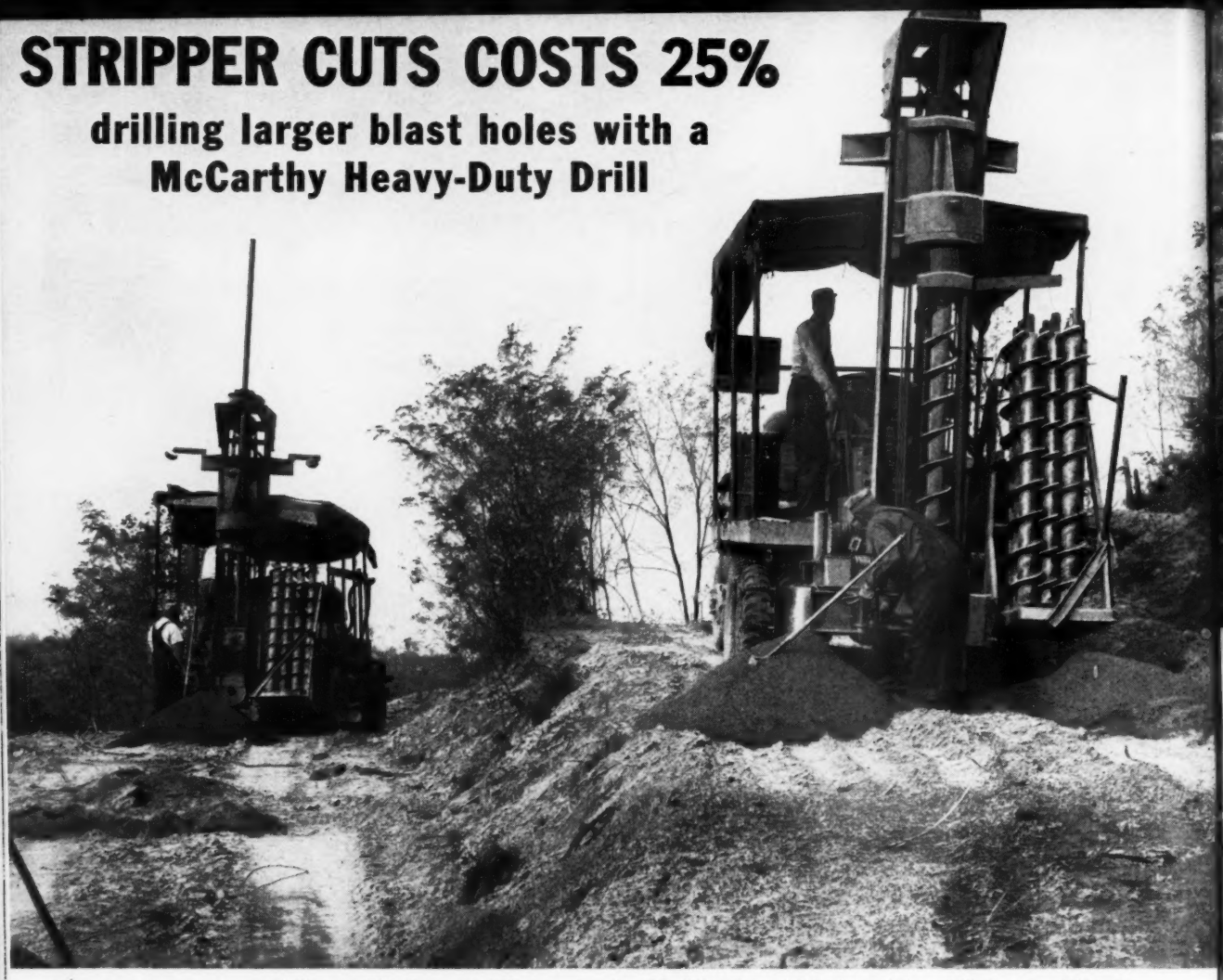
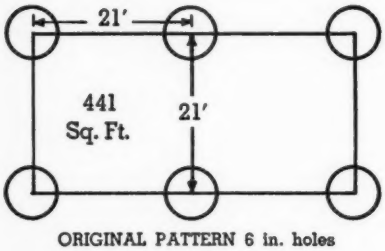
STRIPPER CUTS COSTS 25%

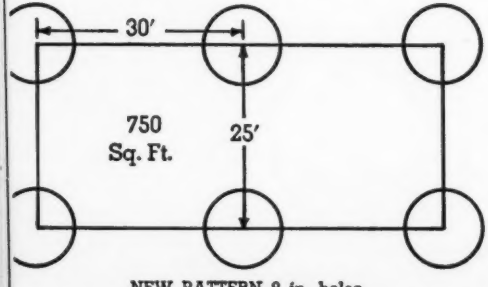
drilling larger blast holes with a McCarthy Heavy-Duty Drill



This strip mine operator cut drilling and blasting costs 25% by using this 25′ x 30′ pattern of 8 in. blast holes—drilled by two McCarthy Heavy-Duty Vertical Auger Drills.



ORIGINAL PATTERN 6 in. holes



NEW PATTERN 8 in. holes

A Southern Ohio strip mine operator cut his drilling and blasting costs by 25% when he widened the blast hole pattern and switched from 6 in. diam. to 8 in. diam. holes. He used McCarthy Heavy-Duty Vertical Auger Drills and a new type of explosive to remove the sandstone overburden.

A cost study made by the operator shows that the McCarthy drill bored the 8 in. holes at less cost than the 6 in. holes. Four 6 in. diam. holes covered 441 sq. ft. Four 8 in. holes covered 750 sq. ft. Since fewer 8 in. holes were required to drill the same area, over-all drilling time was cut in half. In each pattern, the amount of hard rock drilling was the same. The study included five work shifts of two McCarthy Model 106-24 Auger Drills, one using 6 in. and the other using 8 in. flights. The stripper figured all drilling and blasting costs, including fuel, labor, bits, explosives, etc. Over-all cost saving was 25%.

McCarthy Heavy-Duty Vertical Auger Drills drill up to 24 in. diam. holes faster than any other auger drill. Start cutting your costs now by phoning the nearest Salem Tool representative. Or write for Bulletin M-100.

Manufacturer of Drilling Equipment Since 19

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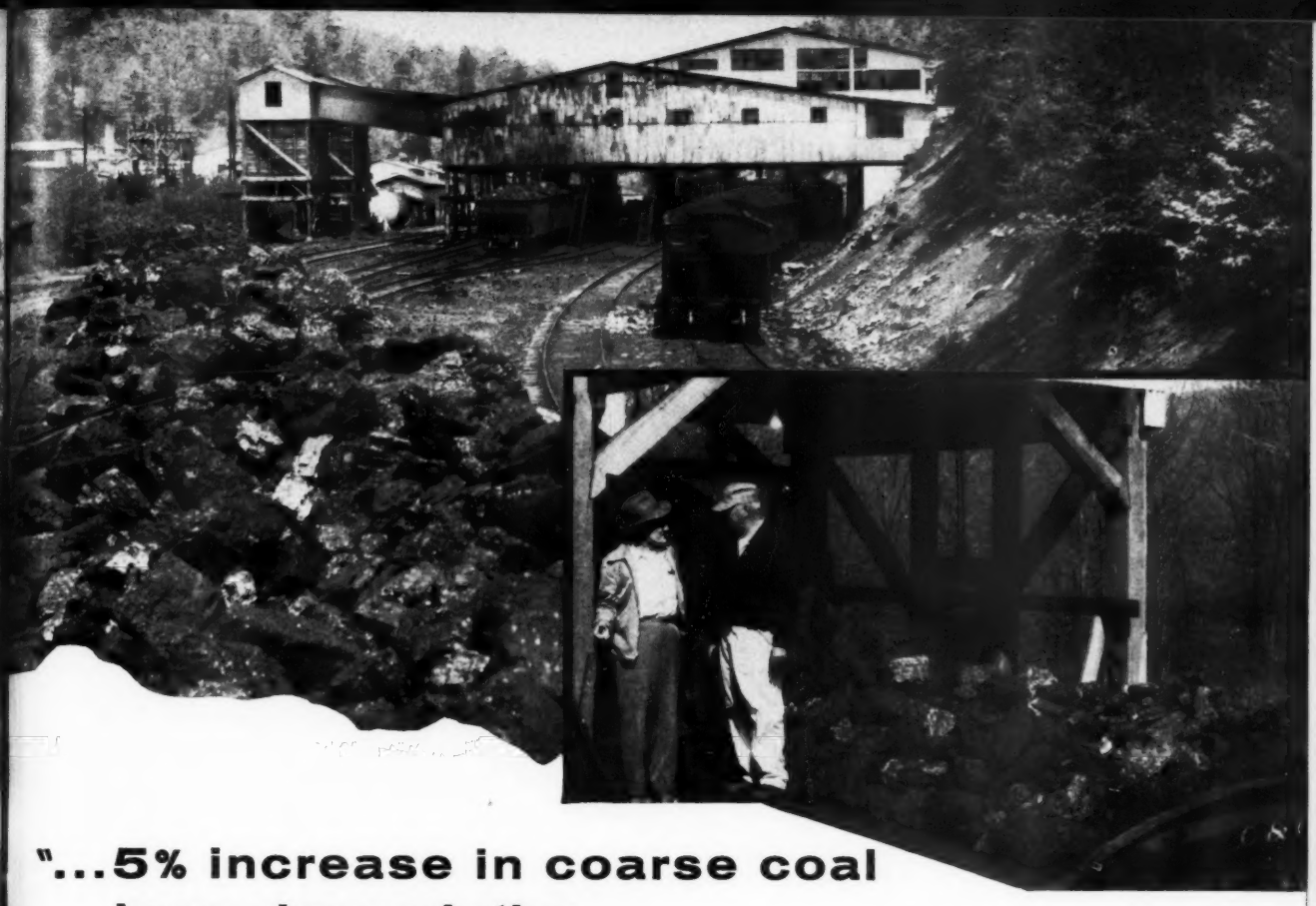

"...5% increase in coarse coal ...less degradation with AIRDOX"

NON-EXPLOSIVE MINING METHOD

NEW RIVER IMPERIAL SMOKELESS

states J. G. McCURRY
General Manager
Imperial Smokeless Coal Company

"We have been using the Airdox method of mining for some five years now in all our deep mines. We gave it a very thorough test period and compared the results with other methods of blasting. Airdox gave us an increase of more than 5% in coarse coal. Moreover, our customers report there is *noticeably less degradation* of coarse coal when unloaded at its destination.

"We have a new mine opening this fall and expect to stay 100 per cent on Airdox."

GET ALL THE FACTS • WRITE FOR FREE SURVEY

AIRDOX

NON-EXPLOSIVE MINING METHOD

Cuts Costs 5 Ways

- Produces less fines in face preparation
- Rolls coal forward for faster, easier loading
- Easier on "tender" roofs—cuts timbering, bolting
- Lowers cleaning costs by minimizing fines
- Reduces degradation—no shattered coal

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NEW THOR SELF-PROPELLED ONE-MAN DRILLCAT

First on-the-job reports prove Drillcat delivers more work, bigger profits, in less time

CHECK THIS PROOF DIRECT FROM THE JOB

PAID FOR ITSELF IN ONE JOB

A net profit of $15,000 in one week on rock drilling jobs was reported by one contractor—another, equipped with five Thor Drillcats paid for them in three months from extra profits.

SAVES OVER 2½ HOURS SET-UP TIME

You can set a Thor Drillcat in drilling position—ready to go—in 20 to 25 minutes.

FAST WHEN THE GOING IS TOUGHEST

One man on a Drillcat tugged a 600 c.f.m. air compressor ½ mile over rough terrain, drilled five holes and was back with equipment at his starting point in only two hours.

DRILLING TOE HOLES. The Thor Drillcat is completely flexible. The boom and mast are lowered flat to the ground for toe and lifter holes. Twin reversible drive air motors permit easy maneuvering to any position, any angle. (Note position of controls for easy operation.) A "dead man" control for all air valves is standard equipment on the Drillcat.

DRILLING DOWN HOLES. Two 7½ h.p. air motors propel this compact (6 ft. 9 in. overall) Thor Drillcat where no other crawler can go. More than enough power to pull its own air supply. Drilling down holes is no chore for Thor's Drillcat. Using the powerful model 105M drifter and chain feed mast, the hydraulic accumulator keeps boom rigid at all times. This means less steel breakage and less wear on chuck parts.

These exclusive features make Thor model MM-2 Drillcat the most productive rock-drill you can buy! Ask any Thor distributor for a Drillcat demonstration.

● Thor's super-powered 105M drifter rock drill. ● Rugged Thor BW-2 wagon drill mast and air control motor. ● Self-propelled with two 7½ h.p. Eimco air motors, power aplenty to haul itself and air supply. ● Rigid frame, proved in tractor design, no moving or wearing parts, long lasting, low maintenance. ● Aircraft-type accumulator in hydraulic system absorbs shock. ● Simple hand-operated track take-up. No tools required. No track locks required. ● Large flat platform. Ideal for operator when drilling toe holes, good for tool and fuel storage.

Thor
PORTABLE POWER
TOOLS

THOR POWER TOOL COMPANY
PRUDENTIAL PLAZA, CHICAGO
Branches in all principal cities

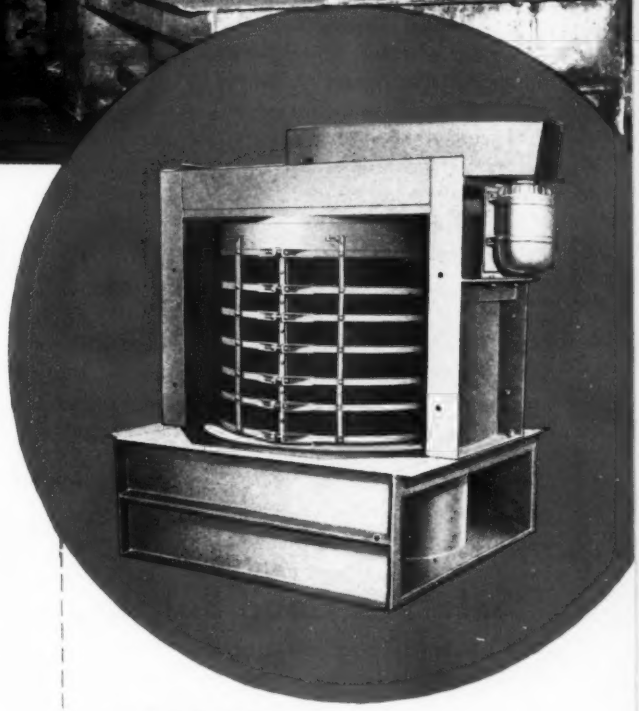
These four Symons V-Screens are installed at Jamison #9 Mine of Consolidation Coal Company (W. Va.) where they are used for dewatering ⅜" x 10 mesh bituminous coal.

SYMONS® V SCREENS

give users maximum efficiency in FINE COAL PREPARATION

The SYMONS V-SCREEN combines centrifugal force with gravity to do a better screening job—make sharper separations—and give you a much dryer product with less degradation than other dewatering methods. It will reduce surface moisture by at least 50%, even on fine coals . . . requires only 5 hp to operate under full load . . . and is the *only* screen that does not depend on gravity alone to size or dewater.

The capacity of the Symons V-Screen is over twice that of a conventional type vibrating screen, per square foot . . . with average tonnages ranging from 35 to 70 tph per screen. In addition, its new screening principle gives extremely long screen cloth life.



FEATURING:

- HIGH CAPACITY
- EXTREMELY ACCURATE SIZING, EVEN IN THE FINER MESHES
- HIGHLY EFFICIENT DEWATERING
- FULLY ENCLOSED — DUSTLESS OPERATION
- EASY REPLACEMENT OF SCREEN CLOTH
- MINIMUM FLOOR SPACE REQUIRED
- LOW COST OPERATION

SEND FOR FREE BULLETIN

Write for your copy of Bulletin 243, which gives the full story on Symons V-Screens.

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SYMONS . . . *A REGISTERED NORDBERG TRADEMARK KNOWN THROUGHOUT THE WORLD*

Editorials

ROBERT W. VAN EVERA, *Editor*

FEBRUARY, 1957

1956 in Review

THE year that has passed is brought into focus in this annual *Mining Review*. MINING CONGRESS JOURNAL is proud to present to its readers this comprehensive report of activities and new developments in all branches of the mining industry. The men who have written the articles are all authorities on their subjects, and the JOURNAL is deeply indebted to them for contributing hours of study, research and composition, to keep the industry informed on vital matters affecting it.

In the pages that follow you will find concise analyses of economic developments in the various extractive industries, together with a recounting of technological advances in such fields as underground and open pit methods and equipment, geology, mineral processing and preparation, and research into new uses for mineral products. These articles, covering coal, metals and non-metallic minerals, warrant careful study by every person who has an interest in the mineral industries.

Safety Is Good Business

THE present surge of the American industrial machine, accompanied by strong competition on all sides, has sharpened the wits of businessmen the country over and prompted them to investigate every conceivable possibility of producing a better product, increasing efficiency or cutting costs to make available more capital for expansion. Industry has never been more research-minded or record-conscious. Both new and old management techniques and specialized functions have been applied to solve the impossible—and in many instances they seem to have done just that.

Concerted effort toward greater safety is a basic activity which all managements should continue at an increasing rate. Time and again leading companies have shown that no management function returns sounder dividends—whether measured in dollars, human values or public relations gains—than a successful safety program.

The mining industry's steady progress in accident prevention is highly commendable—but there is room for still further improvement. The industry as a whole is in accord with the American tradition of regarding the physical and mental well being of human beings as a paramount consideration.

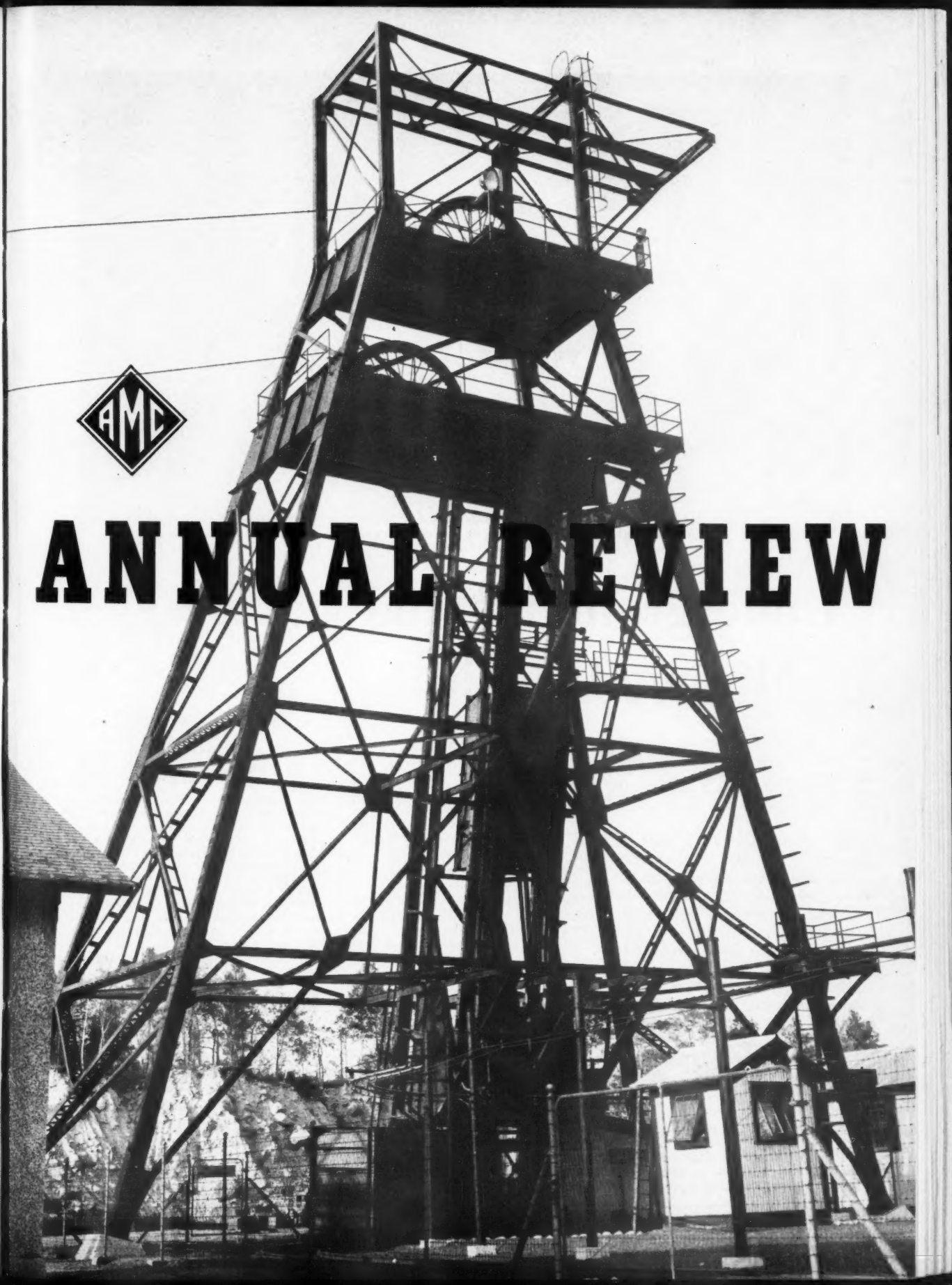
James D. Reilly vice president of the Hanna Coal Division of Pittsburgh Consolidation Coal Co., speaking before the National Safety Council in Chicago, enumerated the necessary links in any successful safety program. The starting point is the recognition by managers and top leaders that they have a challenging responsibility to get actively behind such a program. True, the accident can actually be prevented only on the job where it is likely to happen—not behind the manager's desk. But these leaders, said Reilly, "must be in a moral position to sincerely earn the cooperation and safety-mindedness of the men who work in the mines."

The second link is proper and adequate supervision of the safety program. Safety engineers must be trained in the science of accident prevention, and their departments must be adequately staffed to cover all the areas of operation and to analyze records, pinpoint causes, devise remedies and eliminate hazards.

Following this, link three, without which any program will fail, is the proper training of the workman in how to perform his work safely. This brings the program to the area where the payoff comes—to the area where accidents occur and can be prevented.

The final and most difficult link is to employ every feasible method to prevent the workman from becoming careless in his work habits.

On this basis many mining companies have built successful safety programs. They have set a pattern which others can well follow—and save money in the process. The American Mining Congress through the pages of this JOURNAL and all other means at its disposal is anxious to do everything possible to make mining a safer industry in which to work.



ANNUAL REVIEW

This cat-mounted, 32 cu ft loader was tried as a stope clean up tool to replace scrapers. It did its work well, but was difficult to transport between stopes

Underground Metal Mining Practice

By E. R. BORCHERDT
Director of Mining Research
The Anaconda Company

E. R. BORCHERDT, director of mining research for The Anaconda Company, is a familiar figure in mining circles throughout the world. His formal education was received at the Michigan College of Mining & Technology, and the University of Michigan. He went to Butte following graduation in 1920, and after working for a short time in Anaconda's geology department he became research engineer and has worked on improving operating methods and equipment to the present day. Since a list of his many noteworthy accomplishments in mining engineering would fill a volume, and since he has spent his entire professional career with one company, it is difficult to condense the story of Ed's career here except by referring to the accompanying article which will give readers the opportunity to benefit by his rare combination of abilities as a profound researcher, a practical application expert, a sound engineer and an able administrator.

THE continuing high rate of business activity throughout 1956 has been reflected in the heavy demand for metals and mineral products. Technological advances in equipment and methods have kept step with this increased production tempo, achieving higher production rates and lower unit costs in the face of ever increasing wages.

Significant advances have been made in underground practices including drilling, breaking, loading, ground support, haulage, hoisting, and related activities.

Drilling and Blasting

There have been changes in drilling practice, as regards hole sizes. Certain burn cut rounds are now being drilled with 5-in. bits and 5½-in. rock drills, while on the other hand there has been a general reduction in hole size to 1¼-in. and smaller. The continued improvement in carbide insert bits has been responsible for these changes.

A very definite trend away from screw type bits to tapered socket construction has appeared. At least one manufacturer supplies a throw-away type of carbide insert bit which is used to destruction without the necessity of resharpening. This bit yields high footage and at the same time provides a low cost tool which reduces the hazards of pilferage and abuse which previously have had an adverse effect on carbide bit costs.

Small hole drilling in both mining and development work has contributed to greater life for drill steel rods. Experimental work with carburized drill steel rods during the past few years has given most encouraging results. It now appears that the combination of ⅞-in. hexagon carburized rods, small tungston carbide insert bits, and feed leg drills will not only

increase the potential drill footage rate but also make possible total rod footages far beyond the fondest hopes of a few years ago. It also appears that the ideal practice, barring accident or abuse, and an economically sound one, will be to discard drill rods after the first break. It is hoped that the use of rubber collars on hexagonal steel, observed at many African mines, can be adapted to all rods used with push feed drills and that this will result in the elimination of much breakage at the chuck end presently caused by metallurgical notching.

There is a very definite trend in underground drilling towards increasing use of small hole, push feed drilling, and to long hole drilling with extension rods.

Rotary drills have now been developed, with high pressure hydraulic feeds, which have drilled up to 22 ft per min in marble, limestone, soft sandstones and certain ores of copper, iron and lead. These machines drill holes 1⅜ in. to 1⅝ in. in diameter, to a depth of 12 ft, using tungsten carbide spade point bits and hollow drill steel. Such equipment was recently installed in a contract tunnel being driven for the City of Chicago Water Department.

Experimental work with a combination of rotary and percussion drilling is being conducted by the St. Joseph Lead Co. Bonne Terre division.

During the past year dynamite stick lengths have been increased, to reduce loading time requirements. It is felt that a very fertile field exists for the development of a better mechanical means to speed up the present time consuming hand loading practice. The pneumatic equipment used in Sweden, and that provided by one manufacturer in this country, have had only limited acceptance and no endorsement whatever by the powder manufacturers.

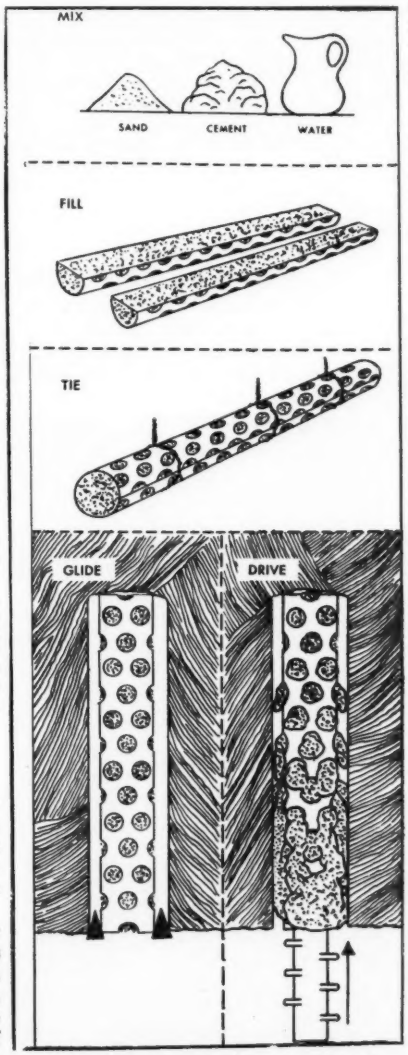
Millisecond electric delay detonators are being improved in quality and uniformity. The use of igniter cord achieves improved delay timing with cap and fuse blasting. Both of these blasting systems are finding increasing application.

Loading

Although no novel designs were forthcoming, all forms of underground loaders were improved during the past year. Definite increases in the use of trackless loading equipment were noted.

A cat-mounted Eimco 630 loader equipped with a 32-cu ft hopper was applied to a timberless cut and fill stope in Butte in an effort to obtain better stope cleanup than possible with a double drum scraper. All of the broken ore was recovered, as there was no trenching such as results from operation of a slusher to require hand mucking to clean up. Tramming its load 50 ft to the chute, this loader moved ore at the rate of one ton per min. The principal problem, however, was involved in hoisting this large equipment from floor to floor through an oversize timbered raise. This consumed so much time that the production cycle could not be maintained at the same rate as a scraper operated stope. In an orebody where chutes can be suitably spaced, and where timbered raises would not be required there may be yet an efficient application for this type of equipment. These experiments definitely showed that cat-mounted equipment can be operated on freshly placed hydraulic sand fill.

A 3-car train loader similar to the Boliden and the Pierce loaders has been designed for use with the Model 105 diesel driven Eimco loader. This unit has a capacity of more than 200 tons and will contain an entire round up to 12 ft of 14 by 17 tunnel heading. It will go into service in the near future in the main adit of the El Salvador mine, the new Anaconda property in Chile.



The perforated steel sleeve used with stiff grout is an innovation in rock bolting

It is understood that a small diesel operated over-shot loader is being designed for sublevel stoping development where diesel exhause would not complicate the ventilation.

A big brother to the 18HR2 Joy loader has recently been constructed which has loaded 800 tons of abrasive Kiruna iron ore per shift. A capacity of 20 tons per min is anticipated from the Model 19HR3 machine. This type loader uses a belt conveyor instead of the usual chain conveyor.

A new practice has appeared recently in trench loading of skip pockets where two 150 hp double drum scraper hoists equipped with narrow, large diameter drums are used, without tail sheaves. One hoist is located at each end of the trench with two 72-in. scrapers between, each scraper having a rope from the haul drum of one machine and a rope from the tail drum of the other machine attached to it. In this way the ropes to each scraper come directly off the slusher drums, and no tail sheave is required.

Ground Support

The use of rock bolts to support ground in drifts, stopes, raises and shafts was greatly expanded again during 1956. The split rod and wedge type bolt has been replaced to some degree by the expansion shell type. Advantages of the latter type are that depth of bolt hole is not critical and that it can readily be retightened.

Another advance in rock anchoring and bolting consists of a perforated steel sleeve that is filled with stiff grout and placed in the drill hole. A steel reinforcing bar or rock bolt is then driven into the hole forcing the mortar through the perforations in the sleeve and filling solidly all the space between the sleeve and the surrounding rock. This gives large bearing and is useful in soft rock when conventional bolts slip or pull out.

Exhaustion of the stock of used steel air field landing mats for use with rock bolts has brought cyclone fencing into use as a substitute.

For support of heavy ground in block caving, concrete or yieldable steel sets are replacing timber, choice depending upon conditions. An increase has been noted in the use of pneumatic placers as compared to pumpcrete equipment, but the pneumatic placers require an expert and conscientious crew for good quality concrete.

Hydraulic props or posts and yieldable steel cantilever posts, in general

Further mechanization of the handling of mine timbers has been accomplished at Anaconda's sawmill at Bonner, Mont.

use in Europe, were being tried recently in several U. S. mines.

The value of hydraulic filling as a means of stope support and for stabilizing large filled stoped areas is receiving greater recognition and application each year. Classification equipment is now available which will produce from most mill tailings suitable hydraulic fill material that is safe, readily permeable, will drain quickly, and at the same time contain a sufficient quantity of slime to afford lubrication necessary to minimize pipeline wear and to give proper packing or consolidation properties. When sand fill is properly dewatered it consolidates and weight is transmitted to the walls instead of being transmitted down through the stope fill to the sill supports—as is the case with other types of fill.

During the year experiments were conducted to attempt to reduce the amount of slime cleanup required on sills by the use of flocculants, and also by increasing the percentage of solids in the fill slurry. Another advantage expected with high density slurry, 70 percent or more, is substantial reduction in pipeline wear. The best example of hydraulic filling practice, in the opinion of the author, is at the Knob Hill mine at Republic, Wash., where the solids in the slurry are maintained at 70 percent or more by means of a centriclone at the shaft collar. This material flowing from the fill line resembles sausage being extruded from a sausage machine.

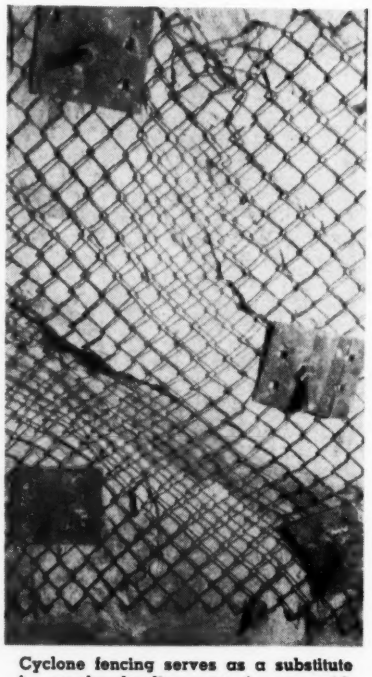
A modern sand fill slurry plant was recently put into operation at Butte to serve several mines. With the installation of automatic density control it is hoped that a 70 percent slurry can be continuously maintained.

Studies in rock stresses have been conducted during the year by several mining companies in cooperation with the U. S. Bureau of Mines, and should supply valuable information on ground support.

To facilitate mechanized handling of mine timber by lift trucks at the Butte mines a new framing and packaging mill was recently completed at the Anaconda Company sawmill at Bonner, Mont. Round stulls are cut to length and automatically slabbed on four sides before framing, which is done at the rate of 10 pieces per min. Timbers are then made up into unit loads in a mechanical stacker, and steel strapped.

Transportation

A number of important improvements have appeared during the year in trackless equipment. A shuttle car which will carry a 15-ton pay load up a 35 degree incline is operating successfully in the Blind River uranium district.



Cyclone fencing serves as a substitute for surplus landing mats for use with rock bolts

Twenty-five ton side dump cars were being installed recently in a large Rhodesian copper mine, following satisfactory experience with this size car in another Rhodesian mine. These cars are dumped by an electrically operated overhead lift. Cars of this capacity were also observed in one of the large Swedish iron mines. Such large cars require underground crushers if skip hoisting or belt conveying is involved.

Some African mines are operating both ore and man car trains at speeds up to 35 mph. This of course requires well ballasted and carefully graded track of the first order, and 91-lb rails.

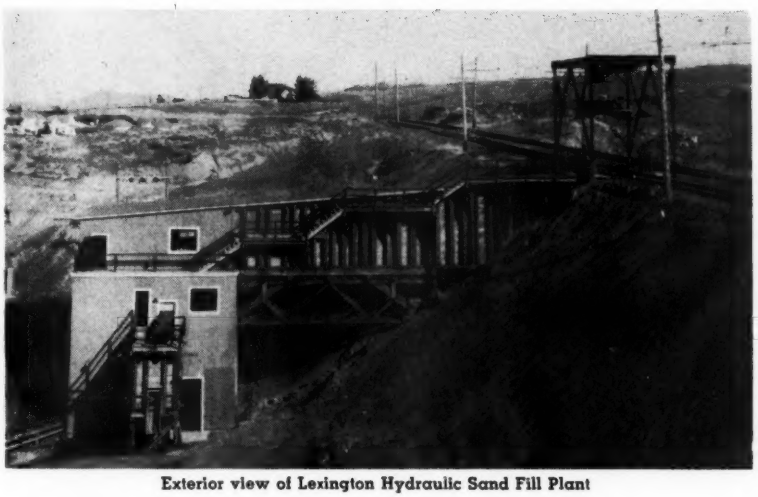
Shaft Sinking

Records were again advanced during 1956 in sinking circular, concrete lined shafts in South Africa, where it is believed probable that within the next few years sinking speed will reach 1000 ft per month. A circular shaft section makes it possible to use a multiple deck Galloway stage, with which pouring of concrete can be carried on simultaneously with drilling or mucking in the shaft bottom.

It is the opinion of South African engineers that the limit of shaft advance with hand lashing or mucking has been attained, and that henceforth mucking will be done entirely by mechanical means. Last Spring the author observed mechanical loading of six-ton sinking buckets in an average time of 1-½ min. Total cleanup time was three hours for a 400-ton round broken in a 25-ft diam shaft. This was done with a cactus grab or orange peel attached to the bottom of the sinking stage so that it could be rotated 360 degrees.

It is notable that during the year a number of circular shafts were begun in North America. A 1700-ft deep, concrete lined circular shaft 18 ft in diameter was completed by the Dravo Co. for the Intermountain Chemical Co. at Green River, Wyo. Homestake recently started a 19-ft diameter circular ventilation shaft which will ultimately be sunk 5000 ft. A 14-ft circular shaft is now being sunk at Buchans, Nova Scotia. The Hanna Co. recently announced plans to sink a circular concrete lined shaft 20 ft in diameter, at Iron River, Mich. At Carlsbad, N. M., two 15-ft circular concrete lined shafts 1700 ft deep were completed last July. The maximum sinking rate at these shafts was 10 ft per day over a 30-day period.

A Canadian subsidiary of the Potash Company of America is currently sinking a large concrete lined production shaft in Saskatchewan. At a depth of 850 ft refrigeration is being



Exterior view of Lexington Hydraulic Sand Fill Plant

used to stabilize the ground in certain formations.

General practice in mucking rectangular shafts in North America has been to use the well-known Riddell machine, the Boland machine, which is similar to the Riddell, or the Cryderman machine, which was developed in Canada several years ago and has now been introduced in this country.

During the past year the Eimco cat-operated 630 loader was used successfully in the Green River shaft.

Until recently no successful means had been developed for mechanical mucking of incline shafts, but last year the Cryderman vertical shaft mucker was adapted for use in the 55° incline shaft at the Page mine of the AS&R Co. A 5-½-ft round in a shaft section of approximately 20x8½ ft requires about two hr to muck out, using a 45-cu ft skip.

Another interesting inclined shaft mucking operation is being conducted at Metaline Falls, Wash., by the Pend Oreille Mines and Metals Co. This 12° incline, 10 ft high and 18 ft wide, is being sunk with a four-drill jumbo and a Model 630 Eimco mucking into a 10-ton open top skip. Advance for the first 1800 ft averaged 300 ft per month on a two-shift operation.

Hoisting

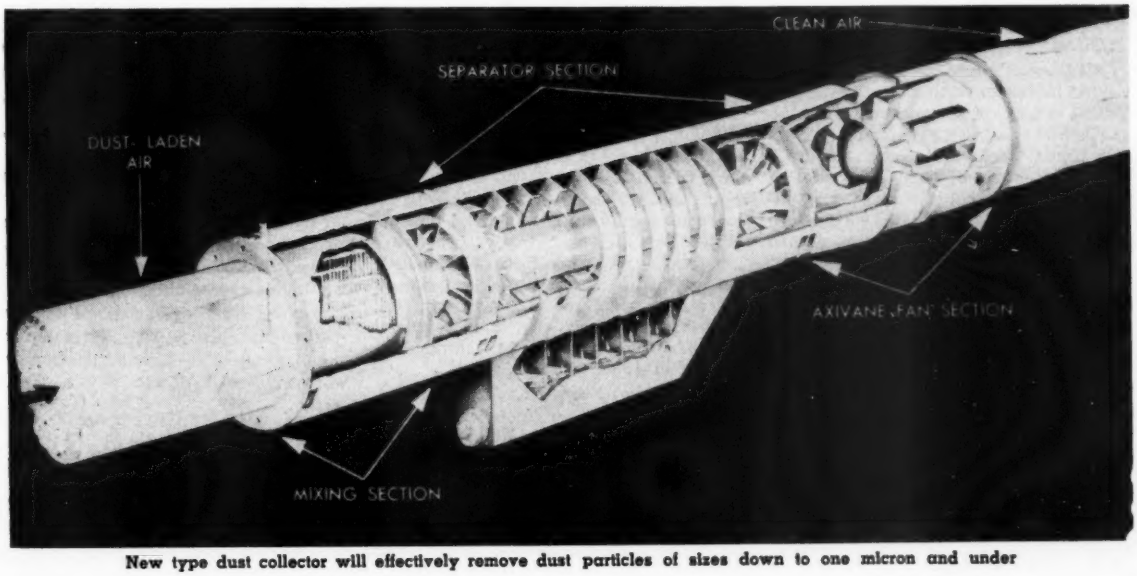
Several large concrete hoist towers were completed during 1956 and fitted with Koepe hoists. The very large multiple installation at Kiruna, Sweden, was completed during the past year. This consists of eight skip units capable of hoisting more than 4000 tons per hour. The largest Koepe hoist ever constructed is now being installed at the No. 5 Driefontein shaft in South Africa. Two 2000 HP motors drive the Koepe sheave to lift a 14 to 16-ton skip 5400 ft. Four 1-¾ in. ropes are used.

A new type of sinking stage hoist has been developed recently by Mr. Robert Blair, Consulting Engineer of the Anglo-American Corp. of South Africa, Ltd., to speed the rate of circular shaft sinking. It utilizes two ropes, multiple sheaves, a double drum friction hoist, compensating tower, and an automatic winding drum for rope storage. Four sheaves on the sinking stage and headframe permit distributing the weight of the Galloway stage to eight ropes at equal tension. The four pairs of ropes in the shaft serve as guides for the four sinking buckets. With the previous equipment not more than four ropes were used to support the stage.

Miscellaneous

A very compact and efficient wet type dust collector has been introduced during the year. This unit is an original development, by the Anaconda Co. Ventilation Department in cooperation with the Joy Manufacturing Co. It will effectively remove dust particles of sizes down to 1 micron and under, with high retention characteristics.

A high strength, light weight galvanized pipe designed for use with Victaulic couplings, manufactured in Sweden, is being investigated by the Anaconda Co. This pipe was observed in use in Swedish iron mines and African copper mines. Since its weight is about one third that of standard pipe, substantial reductions in cost are possible, both for material and installation. Galvanized pipe, to combat corrosion, has been used in the Butte mines for many years.



New type dust collector will effectively remove dust particles of sizes down to one micron and under

Productivity advanced during the year by five percent to 10.8 tons per man-day

Bituminous Coal, 1956

European exports proved to be the frosting on the cake as change in domestic consumption pattern continued

By G. A. LAMB
Manager of Business Surveys,
Pittsburgh Consolidation Coal Co.

GEORGE A. LAMB has been manager of business surveys for Pittsburgh Consolidation Coal Co. since 1946 and has followed closely the basic shift in coal markets that we have experienced since World War II. He has been a member of various coal industry committees and served as consultant to the Cabinet Energy Committee in 1954.

THE bituminous coal market continued to improve in 1956. Production was 500,000,000 tons, 30,000,000 over 1955 and 108,000,000 over 1954.

Additional production in 1956 was mined in response to an estimated increase in U. S. consumption of 15,000,000 tons and in exports of 17,000,000 tons. Consumption was 438,000,000 and exports 68,000,000, a total of 506,000,000. Exports overseas advanced from 34 to 48,000,000, or 5,000,000 tons above the previous record set in 1947. The 20,000,000 tons that moved to Canada was a gain of 3,000,000. These figures have the consumption-export total exceeding production by 6,000,000 tons during a period when consumer stocks increased but this discrepancy may be erased when more final figures are released.

Electric Utilities

Bituminous coal consumption by the electric utilities totalled 156,000,000 tons, 11 percent higher than 1955. It compares with 163,000,000 tons used by the railroads in 1918, the largest annual consumption by a single industry. In 1918, the utilities burned only 32,000,000 tons, while the railroads used but 12,000,000 tons in 1956 as their dieselization program neared completion.

The increase in utility coal consumption took place, to a large extent, during the first half of 1956. It was 18 percent higher in that period but up only three percent in July, when industrial activity declined because of the steel strike, and up four percent during the remainder of the summer. It was six percent higher in the last quarter than during the comparable period in 1955.

A change in the rate of growth of utility coal burn was not to be unexpected. Since 1954, the utilities expanded their coal use by 41,000,000 tons or 36 percent, twice as much as might have been figured based upon historical trends. Contributing heavily to this expansion was the addition of generating capacity using 18,000,000 tons for the production of power required by the Atomic Energy Program. However, AEC activity neared the top of its power requirements by the summer of 1956. Furthermore, the shift from oil and gas slackened. These two developments came about at a time when business was adversely affected by the steel strike.

Steel Coal Consumption Remains High

The steel industry produced 115,000,000 tons of ingots, only 1,000,000 less than in 1955 despite its strike in

July. It used, together with the merchant coke plants, 111,000,000 tons of coal all but 5,000,000 being for metallurgical purposes.

Other Industrial and Retail

Manufacturing and remaining industrial uses consumed 106,000,000 tons, or five percent more than in 1955. Deliveries to retailers totalled 52,000,000 tons, 2,000,000 under the previous year. This market has changed little since 1953 after suffering substantial losses in previous years.

Exports Larger

Exports totalled 68,000,000 tons, a gain of 17,000,000. Preliminary data show the export movement as below:

	Million Tons	
	1955	1956
Canada and Other N. A.	17	20
Overseas:		
Europe	29	42
Other	5	6
Total	51	68

Overseas shipments increased during the summer and amounted to 26,000,000 tons in the second half, as against 22,000,000 tons in the first six months. Shipping tightened and vessel rates advanced late in the year because of the closing of the Suez Canal.

American Coal Shipping, Inc., moved its first cargo of coal in December. ACS was organized early in the summer through the combined efforts of certain coal operators and railroads, and the United Mine Workers of America. Its objective is to promote coal exports, particularly by lowering ocean shipping rates which rises sharply during periods of heavy movement. ACS in the fall got authority from the Government to charter 30 Liberty ships of the reserve fleet, six of which were moved immediately to the shipyards for conditioning. It got an additional 16 ships through its acquisition of the Bull Steamship Line.

Oil Prices Rise

Residual fuel oil prices advanced in June and again in November. Quotations on Bunker C in New York Harbor went from $2.65 to $2.80 per barrel during the last week in June, and advanced further to $3.05 in November. The June rise reflected the growing demand for residual in Europe. In November the higher price took account of an additional factor—the Middle East crisis—which resulted in a shortage of tanker capacity.

The residual price of $3.05 per barrel is equivalent to a delivered price of $12.70 per ton on bituminous coal. This gives bituminous a favorable differential at eastern industrial plants where residual held a price advantage only a few years back. In 1953, Bunker C in New York Harbor had a list of $2.00 per barrel, i.e., equivalent to $8.30 per ton of coal.

Wages Advance

A new wage agreeemnt, dated October 1, 1956, provided for an increase of $2.00 per day of which $1.20 was effective with the start of the new contract and 80 cents on April 1, 1957. It also provided for extending the vacation period from 12 to 14 days, with 11 of them in the summer and three during the Christmas period. Vacation payments amount to $180 in the summer and $40 in Christmas periods, increasing total payments to $220 from $140. Provision was made for double time or double rate for holidays, when worked. This wage contract was negotiated free of a labor stoppage; in fact, bituminous has not had a general strike since early 1950.

Prices

Following the wage advance bituminous coal prices were increased. These ranged from 35 to 40 cents per ton in the Eastern districts according to the National Coal Association. Operators in these districts indicated that these increases returned their price levels to about where they were in 1948.

Since 1948, the bituminous coal industry has had five general wage advances and substantial increases in what it pays for materials, supplies and equipment, the latter because of more complex mechanization as well as higher prices. Based upon the wholesale price index of the Bureau of Labor Statistics, mining machinery and equipment had an average price in October 1956 that was 82 percent above the average for the 1947-49 period.

Rates and Shipping

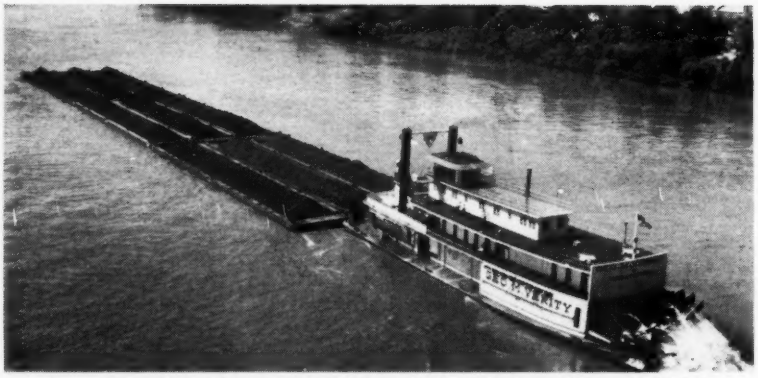
Two general freight rate increases were applied to coal in 1956. On March 7, the Interstate Commerce Commission, as a result of its decision in Ex Parte 196, authorized the railroads to increase coal rates six percent to a maximum of 15 cents per ton, with certain exceptions. Its decision in Ex Parte 206 authorized the railroads, effective December 28, to apply a flat increase of 10 cents per ton on coal, again with certain exceptions.

UNITED STATES CONSUMPTION
AND EXPORTS OF BITUMINOUS COAL
(Million Tons)

	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956*
1. Railroads, Class I	110	109	95	68	61	54	38	28	17	15	12
2. Retail Deliveries	101	99	90	90	87	77	68	61	53	54	52
Total (1 plus 2)	211	208	185	158	148	131	106	89	70	69	64
Percent Grand Total	38.9	33.9	32.6	33.5	30.8	24.8	22.8	19.3	17.8	14.6	12.6
3. Electric Utilities	69	86	96	81	88	102	103	112	115	140	156
4. Steel and Coke	92	115	117	99	112	121	104	119	90	113	112
5. Industrial and Other	129	137	122	108	107	115	105	106	88	101	106
Total (3, 4 & 5)	290	337	335	287	307	338	312	338	293	354	374
Percent Grand Total	53.5	54.9	59.3	60.7	63.9	64.4	67.0	73.3	74.4	74.6	73.9
6. Total U. S. Consumption (1-5)	500	546	520	446	454	469	419	427	363	423	438
7. Exports to Canada	22	26	26	16	23	23	21	20	16	17	20
8. Exports Overseas	19	43	20	12	2	34	27	14	15	34	48
Total Exports (7 & 8)	41	69	46	28	25	57	48	34	31	51	68
Percent Grand Total	7.6	11.2	8.1	5.9	5.3	10.8	10.2	7.3	7.9	10.8	13.4
9. GRAND TOTAL	542	613	566	473	480	526	466	461	394	475	506

SOURCE: U. S. Bureau of Mines (Figures may not add to total because of rounding).

* Partly estimated.



Despite a strike in July, the steel industry's demand for coal remained high

Shortages in railroad coal car supply began to appear in particular areas during the spring and they became pronounced after the steel strike in July.

Tests were completed on the coal pipeline of the Pittsburgh Consolidation Coal Co. This line, extending 110 miles from the company's Georgetown plant to the Eastlake Station of the Cleveland Electric Illuminating Company, is expected to be in operation by early 1957.

Capacity Expansion

A number of companies started building additional mine capacity and others announced plans for new mines to be started in the near future. Mine employment increased five percent, averaging 226,000 as counted by the Bureau of Labor Statistics. Further adding to capacity was the improvement in productivity.

Preliminary figures show that output per man-day was 10.8 tons or five percent better than in the previous year.

10 Years of Change

The year 1956 closed a post-war decade during which significant changes occurred in the fuel structure. Since 1947, the increase in the sales of refined oil products has been over 50 percent and in marketed natural gas 100 percent. Over the period, anthracite lost more than half of its market and bituminous coal sales were lower by 20 percent. Bituminous, however, after a steady decline of seven years, started to regain position in 1955 and is now looking to production records in the future. A new energy source for industrial use — atomic power—was introduced during the past decade although it will be some years ahead before it becomes a serious competitor with conventional fuels.

Loss of railroad fuel sales was a major disturbance in the coal market. Coal sold to the railroads had provided the basic mine realization; it was a sure source of income on better than one-fifth of the commercial production. During the decade, the railroads steadily shifted to diesel power to displace 100,000,000 tons of locomotive fuel-coal.

Both oil and natural gas gained heavily at coal's expense in the market for heating fuels. Bituminous coal retail sales were reduced 50,000,000 tons, a loss of considerable volume but one that was especially significant from a price standpoint. Retail coal sold at a premium and it offered prospects for a profit. Loss of these, along with reducing railroad sales, depressed mine realization, too often affording the operator little chance to get enough from his prices to cover costs.

Industrial buyers used 11 percent more bituminous in 1956 than in 1947, the year of record bituminous production. This reflects mainly the 83 percent increase in coal use by the electric utilities. Metallurgical consumption stayed about the same between these years but manufacturing and the remaining industrials declined, principally because many of the smaller plants changed to oil and gas. The utilities, coke plants and larger manufacturers are expanding and will need more coal. Oil and gas, which previously got a good part of the industrial steam business, are confronted with mounting costs and are turning more and more to the markets where higher prices prevail. Oil depends mainly on transportation customers and it, along with gas, wants the outlets where convenience can be featured. Bituminous looks to a growing consumption of its product because of its favorable prospects as a steam fuel which will more than offset what remains to be lost among the railroad and retail buyers.

Overseas exports are becoming more attractive as the market for a substantial tonnage. They fluctuated widely in the last decade and were considered to be a hazardous business until 1955. Then it was established that European and other foreign countries would have to import fuel to satisfy requirements of their growing economies. These countries expect to buy American coal indefinitely where previously they had taken it on a temporary basis with Government assistance on the theory that their own coal production would eventually be raised to meet their needs. However, it now has been admitted that their peak coal production has been reached and their additional coal supplies must be imported.

New Markets

Bolstering coal's prospects are the appearance of broadening markets. Much of the new capacity under construction by the aluminum industry

(Continued on page 104)

On October 1, 1956, wages increased $1.20 per day with another 80 cents to be added on April 1, 1957

Last year saw the attainment of full production from Asarco's Silver Bell operation in Arizona

Copper In 1956

Sharp price fluctuations, mine expansions and labor peace are highlights

By ENDICOTT R. LOVELL
President
Calumet & Hecla, Inc.

ENDICOTT R. LOVELL has devoted his professional career almost entirely to the copper industry. Immediately following army service in World War I he spent his school vacations working in the underground mines of Calumet & Hecla. After graduation from Michigan College of Mining & Technology in 1922, he performed many technical tasks as assistant superintendent and superintendent of his company's smelting and refining department. He advanced successively through management assignments and was elected president in 1944. Under Lovell's leadership Calumet & Hecla, Inc., has expanded and diversified both its mining and copper manufacturing divisions as well as building a new forest industries division and entering into the production of aluminum, steel and chemical products.

CHAOTIC market conditions characterized the copper industry in 1956, overshadowing such significant achievements as an increase of 10 percent in the Free World's primary production, mine expansions and relative labor peace.

Instability of world copper markets during the year was exemplified by wide price fluctuations—from a high of about 55 cents per pound to a low of about 33 cents. Loss of production at the beginning of 1956, coupled with high world demand, resulted in a feverish scramble for copper in the first quarter which sent the price to record heights for modern times.

Price Peak in First Quarter

Heavy demand and scarcity of copper early in the first quarter gave way to lessened demand and an abundance of the red metal even before the second quarter began. At the outset of 1956, the major domestic producers' price was 43 cents per pound and custom smelters were selling at 50 cents —about the same as on the London Metal Exchange.

By February, custom smelters had moved their quotations to nearly 53 cents and the "dealer" market was even higher. During the second half of February, the pressure of copper demand resulted in a price advance by domestic producers to 46 cents. Shortly after mid-March the London Metal Exchange price reached 54½ cents, and custom smelters and dealers reportedly consummated sales at as high as 55 cents per pound for prompt shipment. High grade scrap sold at prices above the producers' quotation. The year's price peaks were reached at that time.

On May 29, in the face of easing demand and more comfortable supply, custom smelters dropped their price to 40 cents. By the end of June, the London Metal Exchange price had slumped from the March peak of 54½ cents to 32¾ cents. Meanwhile, major domestic producers held to the 46-cent level.

Early in July, custom smelters reduced quotations to 37½ cents, a move quickly followed by a major domestic producers' reduction from 46 cents to 40 cents. In mid-July, largely because of the Suez Canal dispute, there began a marked recovery on the London Metal Exchange which, on August 7, reached approximately 40 cents from a previous low of about 33 cents.

WHERE COPPER IS USED

Industry Division	Percent
Electric lines (light, power and communications)	19
Electrical equipment (including communications equipment	18
Construction including building materials, pipe and tube for plumbing, and sheet metal	14
Motor vehicles	8
General components	6
Consumer durable goods	3
Miscellaneous industries	3
Electronics	2
General industrial equipment	2
Railroad equipment	2
Scientific and technical equipment	2
Engines and turbines	1
Metalworking equipment	1
Military (Conjectural)	17
Undistributed	2
Total	100

Source: Copper & Brass Research Association. Computed from Business Reports of the Copper Division, Business Defense Services Administration, Department of Commerce, supplemented by CABRA regroupings and estimates.

This recovery was short-lived, however, and a new decline soon began.

By late October, custom smelters had cut their price to 35 cents and the London Metal Exchange price dropped once more to about 33 cents, bringing about a further cut by domestic producers from 40 cents to 36 cents. Here the price line held, and the market became stabilized for the remainder of the year.

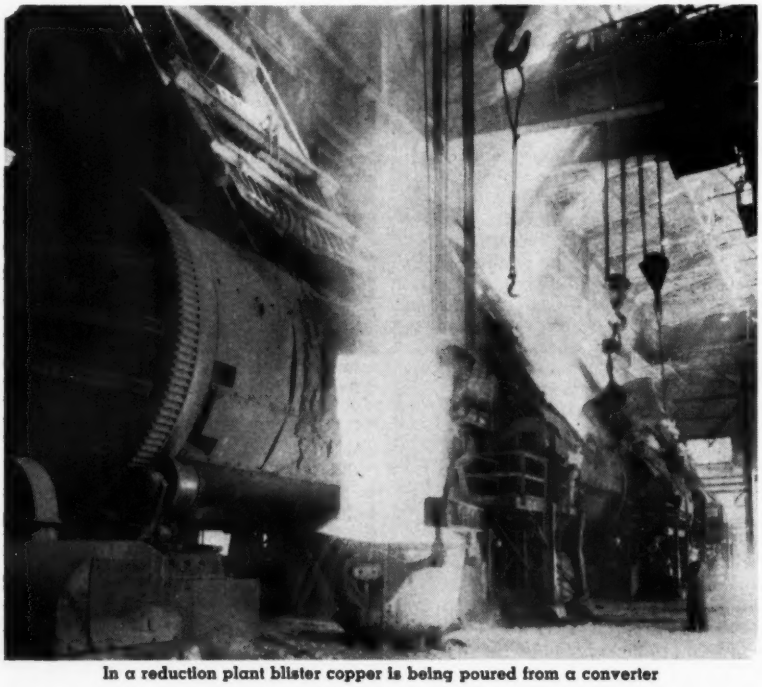
Labor Stable at Home, Uneasy Abroad

Strikes at properties of Chilean producers and at a major U. S. refinery caused a loss of approximately 42,000 tons of copper early in 1956. Labor troubles also affected operations in the African "Copper Belt." A series of strikes swept Rhodesian mines in August and September, a result of inter-union disputes.

Signing of a three-year wage pact in the United States promises a long period of domestic operations free from labor problems. In 1955, an estimated 5 percent of world supply was lost due to strikes. This figure was sharply reduced in 1956, resulting in higher output and greater consumer confidence in a stable supply. Should labor disturbances threaten in 1957, the strain on supply is not likely to cause dislocations as serious as were faced early in 1956.

Stockpiling Activity Steady

Stockpiling operations generally had little effect on copper markets in 1956. Producers delivered to the General Services Administration 18,000 tons of copper diverted to users in the first quarter of 1954 and the first and second quarters of 1955. These deliveries were completed by June. Another 40,000 tons—which has been diverted to users in the last half of 1955—is being repaid on schedule.



In a reduction plant blister copper is being poured from a converter

Production Up Sharply

Refined copper production in the United States reached a total of 1,580,287 short tons in 1956, 7.7 percent higher than the 1,467,448 tons produced in 1955 according to reports from Copper Institute members compiled by the American Bureau of Metal Statistics. Outside the United States, refined copper output totalled 1,406,459 short tons in 1956, an 11.5 percent increase from the 1,260,861 tons turned out in 1955.

Deliveries to U. S. fabricators reached a total of 1,465,899 tons, up 1.4 percent from the 1,446,354 tons delivered the year before. Stocks at year-end amounted to about 120,645 tons, up sharply from the 61,554 tons on hand one year earlier.

New U. S. Capacity in Operation

U. S. producers' exploration and expansion projects initiated in recent years began to bear fruit in 1956. Among the noteworthy developments are the following:

San Manuel, a Magma Copper Co. property in Arizona, made its first shipment of copper anodes in January. The underground block caving project contains an ore body of about 500,000,000 tons of 0.77 percent copper which is expected to produce about 70,000 tons of copper and 3000 tons of molybdenum concentrates annually. Production in 1956 is estimated at 50,000 tons, with an additional 20,000 tons expected in 1957.

Silver Bell, an operation of American Smelting and Refining Co. in Arizona, began production in March 1954, and by July 1956, a daily average tonnage of 7730 tons of ore averaging 0.93 percent copper were being treated by the concentrator. The operation consists of two open pit mines, Oxide and El Tiro. A plant to recover molybdenite in the ore, which averaged 0.015 to 0.02 percent MoS_2 was completed May 1, 1956. By July, it was producing about 1500 pounds of molybdenite concentrate per day.

The Berkeley Pit, The Anaconda Co.'s new open pit development at Butte, Mont., contains an ore body in excess of 100,000,000 tons, churn drill data indicate. A preliminary pit within the ore body was excavated by a contractor to assure satisfactory metal recoveries. A decision has been made to proceed with the main pit, and the mining will be done ultimately

by The Anaconda Co. Production in mid-August stood at 5500 tons of ore per day, which will gradually be increased to 17,500 tons daily. Production of copper is expected to reach 17,000 tons in 1957.

The **Calumet Division** of Calumet & Hecla, Inc. was realizing production from nine shafts at year-end. The Osceola unwatering and rehabilitation project neared completion. The grade of ore was down from the previous year as a result of continued mining in marginal areas and pillar extraction. Average daily hoist of copper rock increased in 1956 as compared with 1955 when a lengthy strike curtailed output and primary copper production of the division reached the highest level in recent years.

The **Minnesota Hi** ore body of Kennecott Copper Corporation in Nevada yielded about 400,000 tons in 1956 and is expected to yield 1,000,000 tons in 1957, averaging about 1.00 percent copper. The Minnesota project will be completed during 1957, and three-level block caving operations at the adjacent **Deep Ruth** ore body will be initiated to allow production from this source immediately following completion of the Minnesota Hi. The Deep Ruth will produce a total of 25,000,000 tons of ore containing about 200,000 tons of copper. Kennecott's **Ray Mines** Division in Arizona is being expanded to produce an additional 20,000 tons of copper yearly by 1958.

The **Pima Mine** of the Pima Mining Co. in Arizona was scheduled to be in initial operation by January 1, 1959, producing 3000 tons of sulphide ore daily containing 2 percent copper. Copper production will amount to about 54 tons daily.

White Pine mine of Copper Range Co. in Michigan marked the first full year of production from the integrated operations with output of 3,900,000 tons of ore yielding in excess of 37,500 tons of refined copper. Modifications of present operating facilities will increase productive capacity of the mine, mill and smelter. Output in 1957 is expected to increase by an estimated 5000 tons.

The **Inspiration Mine** of Inspiration Consolidated Copper Co. in Arizona is adding new facilities expected to produce an additional 3000 tons of copper in 1957, 7000 tons in 1958 and 8000 tons in 1959—a total increase of 18,000 tons in 3 years.

Copper Cities Division of Miami Copper Co., which went into production in August 1954, followed the general open pit trend in 1956. Rotary drilling is used for all blast holes, and a lower cost explosive called Carbamite is used for dry holes.

Mines Expanding In South America

Among the chief new projects outside the United States is the Southern Peru Copper Corporation's ambitious development of the **Toquepala-Quellaveco-Cuajone** ore bodies in Peru. Combined ore reserves of the three mines as indicated by exploration to date are in excess of one billion tons, averaging slightly over 1 percent copper.

ESTIMATED FREE WORLD COPPER CAPACITY, 1955 TO 1962
(Thousands of Short tons)

	U. S. A.		OUTSIDE U. S. A.		TOTAL	
	Tons	Increase Over 1955	Tons	Increase Over 1955	Tons	Increase Over 1955
1955	1,014*	...	1,997*	...	3,011	...
1956	1,130†	116	2,183†	186	3,313	302
1957	1,190	176	2,315	318	3,505	494
1958	1,226	212	2,391	394	3,617	606
1959	1,237	223	2,444	447	3,681	670
1960	1,244	230	2,578	581	3,822	811
1961	1,278	264	2,652	655	3,930	919
1962	1,278	264	2,666	669	3,944	933

* Source: American Bureau of Metal Statistics.
† Source: Copper & Brass Research Association estimates, based on first 10 months ABMS reports.

Toquepala is scheduled to reach a full operating basis early in the second quarter of 1960. The program consists of preliminary stripping to prepare the mine for a daily production of 30,000 tons of ore, construction of a mill to handle this tonnage and a smelter to handle approximately 40,000 tons of concentrate a month, resulting in an average annual production of blister copper of 124,000 tons for the first ten years of operation. Precious metal content of the blister is minor.

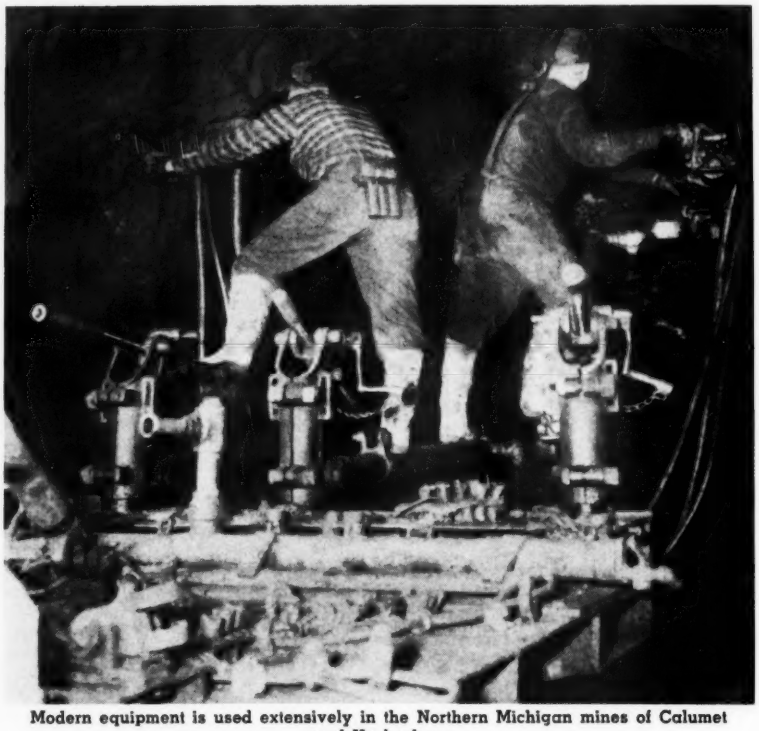
In Chili, Andes Copper Mining Co., an Anaconda subsidiary, will expand operations at its new **El Salvador Mine,** which contains minimum proved ore reserves of 200,000,000 tons of 1.6 percent copper content. The operation is expected to reach full production at a rate of 100,000 tons of copper per year by the end of 1959. It will supplant Andes' **Potrerillos** mine, whose ores will be exhausted in four to five years at present rates of production. Plans for El Salvador call for a crushing plant and concentrator to be built at the mine site. Concentrates will be smelted at Potrerillos, and the company expects production costs at El Salvador to be greatly reduced from present costs.

African Copper Belt Active

Northern Rhodesia's "Copper Belt" has more than doubled its output since 1946, and is expected to total about 580,000 long tons in 1956. Expansion plans under way will raise output by an estimated 40 percent by 1960. Reserves are said to total about 25 percent of the world total, sufficient to produce an estimated 18 million tons of copper.

Rhodesian Selection Trust, Ltd., has scheduled expansions at several properties and is said to be considering enlarging other mines. Its **Chibuluma** mine, with a capacity of 16,000 long

The trend in new copper developments is to open pit operation and higher production rates



Modern equipment is used extensively in the Northern Michigan mines of Calumet and Hecla, Inc.

tons of copper yearly, commenced operations last May. The **Chambishi** mine, last operated in 1931, will be reopened. Operations will begin about 1960 at a capacity of approximately 16,000 long tons a year. Consideration is reportedly being given to expand the **Mufulira** mine by 50 percent from its present 100,000 ton capacity.

Roan Antelope is also said to be considering expansion of its mining properties. **Ndola Copper Refineries, Ltd.**, a Roan Antelope subsidiary, is building a new 110,000 ton refinery, with initial production scheduled for mid-1958 and capacity operations in 1960. Bancroft Mines, Ltd., was scheduled to start operations January 1, 1957, at a rate of 42,800 long tons annually. By 1960, its capacity will be increased to 85,600 long tons per year.

Canadian Development Intensive

In Canada, the search for new copper sources and their development has been intensive also. In 1956, an additional 50,000 tons of copper were produced from Canadian mines, it is estimated by **The Northern Miner**. Another 50,000 tons are expected to be added by 1958, bringing output to about 420,000 tons.

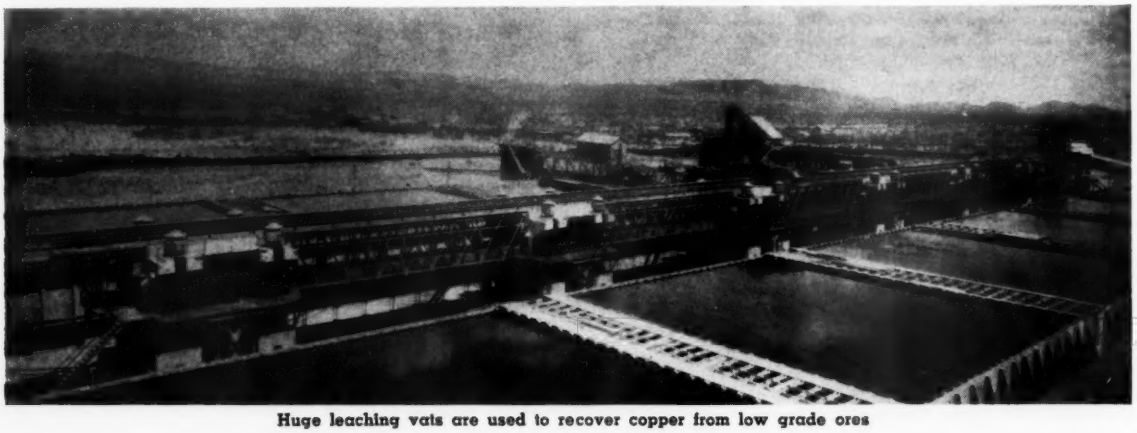
In Newfoundland, Maritimes Mining Corp. hopes to bring its **Tilt Cove** operation into production by May 1957, with the **Gullbridge** property scheduled to follow in a year. **Gaspe Copper Mines** Quebec operation is presently turning out 3340 tons of ore daily from a 67,000,000 ton deposit, and is said to be increasing its daily output to 6500 tons. In northwestern Quebec, three mines are in production: **Campbell Chibougamau, Opemiska Copper** and **Chibougamau Explorers.** Properties under development include **Copper Rand Chibougamau** and **Merrill Island.** Lyndhurst Mining began shipments of ore this year and production began at **Rainville Mines.**

In Ontario, **Consolidated Sudbury Basin** is planning 1000-tpd ore output by summer, and **Geco Mines** is developing a 3000-tpd operation. **Granduc Mines** is working in British Columbia to prove an estimated 30,000,000 ton ore deposit preparatory to initiating production plans next year. It is expected that this property will replace **Granby**, which is exhausting its ore reserves.

Mine Expansions Around the World

Favorable ore developments at the **Mount Isa** copper-lead-zinc mine in Queensland, Australia, have resulted in a decision to increase copper capacity and to erect an electrolytic copper refinery. This mine has been producing about 25,000 short tons of copper annually. The expansion program is expected to increase production to more than twice this amount, but will take several years to complete. Another Australian expansion at **Peko** may attain gradual moderate increases in output.

In Ireland, production from the **Avoca** mine is considered as only initial. Another Canadian company, **Can-Erin Mines, Ltd.**, is also extensively exploring old mine workings and new territory, and other Canadian companies have reportedly entered this field. Other prospects for additional production include The Philippines, where **Atlas** may double its present goal of 30,000 tons yearly, Japan, the **Rio Blanco** deposit in Chili, the undeveloped **Baluba** property in Northern Rhodesia and the Belgian Congo.



Huge leaching vats are used to recover copper from low grade ores

On September 26, 1956, the first pavement was placed on the interstate system under the 1956 Federal-Aid Highway Act. These two paving machines mixed and placed concrete on U. S. 40, near Topeka, Kans., to inaugurate the nation's 13-year program aimed at completion of a 41,000-mile superhighway system

A Record Year In Cement Industry

Although nearly 52,000,000 bbl of additional capacity went into production in the United States during 1956, additional expansion of cement producing facilities aggregating 20,000,000 bbl have already been announced for construction during 1957. Heavy consumption by the construction industry, a rapidly growing population and a large current backlog of needed construction all point to a strong long-term demand for cement

By SMITH W. STOREY
President
General Portland Cement Co.

SMITH W. STOREY, president of General Portland Cement Co., has been associated with the cement industry for more than 30 years. He became president of the Consolidated Cement Corp. in 1935, and was elected president of the General Portland Cement Co. when it was formed in 1947 as a result of the consolidation of Florida Portland Cement Co., Signal Mountain Portland Cement Co. and Trinity Portland Cement Co. Storey has long been an active member of the Portland Cement Association, having served on its board of directors since 1933 and as its chairman in 1951 and 1952.

A record expansion in productive capacity was the top development in the portland cement industry in 1956. Optimism in the industry was high after its tenth consecutive year of record-breaking production with no indication of a slack in over-all construction activity. The competitive position of cement in the building industry is stronger than ever because of the rapid growth in the use of prestressed and thin-shell structures, new designs in conventional reinforcement, new techniques in concrete pavement construction and other technological advances.

A major part of the industry's huge expansion program was completed in 1956. According to announcements in the trade press, nearly 52 million bbl of additional capacity went into production in the United States during the year, an increase of more than 16 percent. This would bring industry capacity up to about 370 million bbl at the beginning of 1957, as forecast by the Bureau of Mines. Official production figures are not yet available for 1956, but Bureau of Mines figures through August indicate production of 312 million bbls for the preceding 12 months.

Although the industry was pushing close to the maximum possible production from existing facilities at the beginning of 1956, the great increase in capacity during the year should allow substantial increases in production in 1957. Additional expansion

plans aggregating 20 million bbl have already been announced for construction during 1957.

Markets

The great expansion of cement producing facilities was undertaken before passage of the Federal-Aid Highway Act of 1956, which authorizes $26.6 billion of federal funds for roadbuilding and sets in motion the greatest single construction program in history. The Bureau of Public Roads estimates that a total of $102 billion will be spent on roadbuilding in the next 13 years, a rate of spending nearly double that of 1955. At the peak of the program, according to the Bureau of Public Roads, an estimated 113 million bbl of cement a year will be used for road construction, approximately 50 million bbl more than present highway requirements. Total requirements over the 13-year duration of the program are estimated at 1.4 billion bbl.

This important increase in cement demand for highways comes on top of another record year for the construction industry as a whole. Despite a ten percent drop in homebuilding, total construction put in place during 1956 is estimated by the U. S. Department of Commerce and Labor at more than $44 billion, a billion-dollar increase over 1955. Another survey places the backlog of heavy construction on which plans have been begun but on which contracts have not yet been let at an all-time peak of $100 billion. The U. S. Departments of Commerce and Labor have forecast a more than five percent rise in construction in 1957, which would bring the year's construction outlay to $46.5 billion.

$102 Billion for Highways

In estimating total highway construction expenditures of $102 billion for the next 13 years, the Bureau of Public Roads assumes state and local expenditures will remain at about the 1956 level and that Congress will increase future Federal aid for the primary, secondary and urban systems. Of the total of $26.6 billion authorized by the 1956 Highway Act, $24.8 billion is for the interstate system over the entire 13-year period of the program, and $1.8 billion is for the other three Federal-aid systems through the program's first three years.

In computing material requirements for the 13-year road program, the Bureau of Public Roads expects highway construction expenditures to rise from the 1956 level of around $5½ billion to a peak of about $8 billion in 1960. This does not include maintenance expenditures. Expenditures for the following seven years should remain near that level, then drop to about $7.5 and $7 billion, respectively, for the last two years.

Cement requirements for highways are expected to rise from about 60 million bbl in 1955 to a peak of 113 million bbl by 1964, according to government estimates. By 1958, the demand is estimated at about 103 million bbl.

Greater use of reinforced concrete and precast, prestressed concrete is also expected in highway structures under the expanded road program. A Bureau of Public Roads highway needs study estimated that a total of more than 300,000 bridges and other highway structures must be built in the decade 1955-1964.

This 24-mile long bridge across Lake Ponchartrain, near New Orleans, La., is the world's longest highway bridge. Completed in 1956, it is built entirely of precast, prestressed concrete elements

One of the largest and most beautiful concrete shell structures in the world was completed in 1956 for the St. Louis, Mo., Municipal Airport Administration building. The roof covers a floor area 120 by 412 ft without supporting columns

Airports

The outlook is good for increased use of concrete for airports. Early in 1956, Maj. Gen. Lee B. Washbourne, Air Force assistant chief of staff for installations, announced that portland cement concrete pavement would be used for all combat air base taxiways and runways. This policy should result in an increase in concrete pavement usage at military airfields.

The amount of pavement constructed at civil airports should also increase in 1957. Increased appropriations under the Federal-Aid Airport Act of 1955 have just begun to take effect and pavement awards should continue to increase during the next two or three years. The Air Force decision to use concrete for all runways and taxiways and the coming of jet transports on civil airlines point to greater use of concrete on civil airports.

Structural Concrete

Thin Shell. The use of thin-shell concrete roofs to span large areas without supporting columns is growing in popularity because of their economy and firesafety. An outstanding shell roof was built for the administration building completed in 1956 at the St. Louis Municipal Airport. Three large intersecting and interconnected barrels give a clear floor area 120 by 412 ft without columns.

Hyperbolic paraboloid shell roofs, a new type of construction in the

United States, have created a great deal of interest because of their striking appearance and the relatively simple formwork needed. They have been designed for large water reservoirs as well as small structures such as gasoline service stations.

Prestressed Concrete. Since the first prestressed bridge was completed in 1950, more than 225,000 ft of prestressed concrete bridges have been built in the United States.

The 24-mile highway bridge across Lake Ponchartrain, La., was completed and opened in the fall of 1956. It was built of prestressed, precast slabs 56 ft long and 33 ft wide placed on prestressed, precast piles. All units were cast on shore and barged to the site.

Another major prestressed bridge was built in 1956 parallel to the old Gandy Bridge across Tampa Bay between St. Petersburg and Tampa, Fla. More than 13,500 ft of this bridge consists of prestressed, precast beams with a cast-in-place concrete deck.

The Illinois Toll Road Commission built and tested a prototype bridge of precast, prestressed concrete pipe piles and girders. When contracts for pavement on the Illinois toll roads were let, bids were asked for 49 bridges similar to the prototype. It is estimated that some 200 similar bridges will be built on the system.

The longest precast, prestressed girders in a building in this country were erected in 1956 in Parkview High School, Springfield, Mo. They are 146 ft in over-all length and clear span is 138 ft inside the supporting columns. The girders are 7 ft deep at the center and 5½ ft deep at the ends.

Some 150 plants producing precast, prestressed elements have been put into production since 1950.

Precasting. The use of standardized precast units is still growing rapidly. Already in many parts of the United States, precast concrete columns, beams, wall panels and other elements can be bought as easily as concrete masonry.

Precast concrete pipe represents a major and growing market for cement. Some 13 million tons of concrete pipe were manufactured in 1955, according to one magazine survey. Production in 1956 may be estimated at well over 13½ million tons if past trends continued.

Ready Mixed May Set Record

A survey conducted by the National Ready Mixed Concrete Association showed production to be in excess of 70 million cu yd in 1955, and the association estimates that more than 100 million bbl of cement were used by the industry in that year. Production has been rising steadily for a number of years and although figures for 1956 are not yet available, another new record was undoubtedly established.

Concrete Masonry Trends

Production of concrete masonry units in 1955 was estimated by one magazine survey at well over 2 billion 8 by 8 by 16-in. equivalent units and it is estimated that 1956 was a year of even greater production. The 1955 figure represented a gain of about five percent over 1954 production.

Important trends in the block field are the increasing use of lightweight aggregates and high-pressure steam curing. About 50 plants now use high-pressure curing, which speeds up production markedly and also produces a higher-strength block of greater stability. The use of lightweight aggregate, producing 8 by 8 by 16-in. blocks weighing 25 to 35 lb each, has grown until now it is estimated to be used in slightly over half of all concrete masonry units.

Soil-Cement

The growing acceptance of soil-cement as a quality low-cost paving material is indicated by the 17 percent increase in total awarded yardage for 1956 over that for 1955. Total soil-cement awards have reached 170 million sq yd in the 21 years since construction in 1935 of the first soil-cement road.

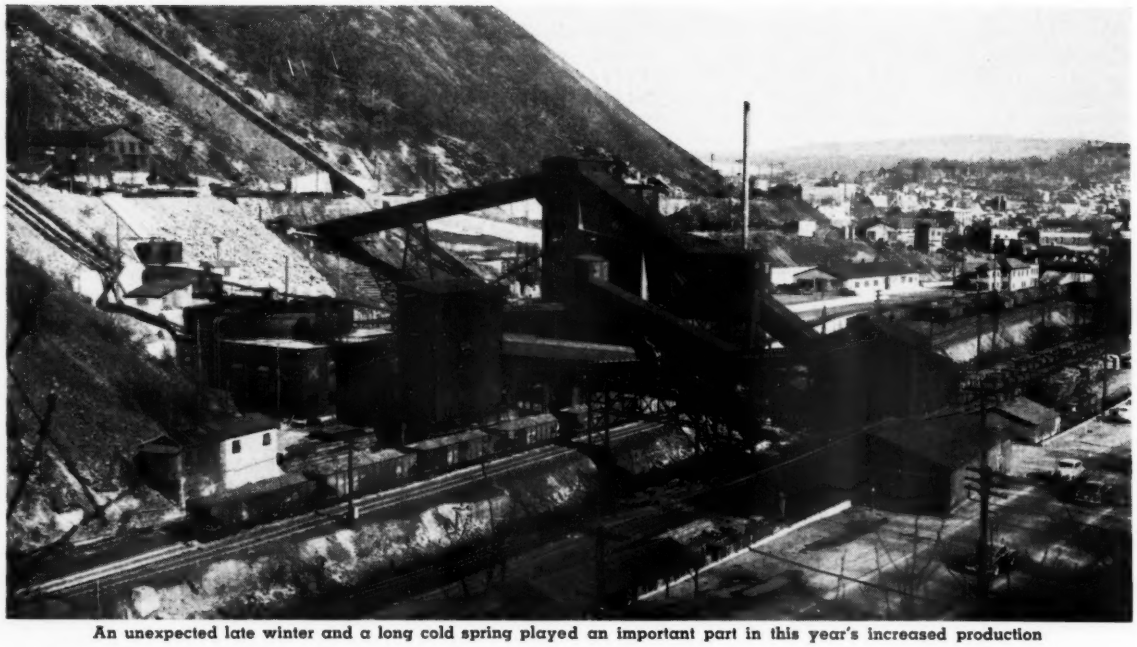
The 1956 Highway Act should greatly expand the use of soil-cement for shoulders and for subbases under concrete pavement. At least 66,000 miles of ten-ft all-weather shoulders will be built for rural sections of the interstate system, and soil-cement will probably be used on a substantial part of this mileage. The high standards specified for the interstate system will also require subbases under most of its concrete pavement. The use of soil-cement subbase has become standard practice on heavy-duty concrete highways in California and has proved highly satisfactory on the Houston, Tex., expressway system.

In addition to its use for shoulders and subbases on expressway projects, soil-cement has been used to pave service and access roads of several modern expressway systems.

Soil-cement also found increasing use on city streets and parking areas during 1956. Outstanding projects included a million-sq yd subdivision street paving program in Mobile, Ala.,

(Continued on page 63)

The Tampa, Fla., plant of General Portland Cement Co. illustrates the expansion that has been going on in the industry. Originally built with a capacity of 1,400,000 bbl a year, it now has a capacity of 4,000,000 bbl a year



An unexpected late winter and a long cold spring played an important part in this year's increased production

Anthracite in 1956

With new markets being developed and a production control plan re-established, the anthracite industry attained a total sales increase of about 2,000,000 tons over the year 1955

By C. A. GIBBONS
President
Susquehanna Collieries Division
The M. A. Hanna Co.

C. A. GIBBONS graduated in mining engineering from West Virginia University. After a background of engineering and administration work in the bituminous fields of western Pennsylvania and West Virginia, he was appointed in 1931 mine manager of the Susquehanna Collieries Co. In 1937 he became operating vice-president of the company. Upon merging of Susquehanna into The M. A. Hanna Co. in 1947, Gibbons was elected vice-president and general manager of The Susquehanna Collieries Division. In 1948 he was given additional duties as director of sales for anthracite, and in 1954 he was elected president of the division.

FOR the first time in a number of years, the production of anthracite increased over the preceding year. The production of anthracite during 1956 approximated 26,700,000 tons, including both union and non-union mines. This is an increase of about 1,600,000 tons or 6.4 percent over the year 1955.

In addition to the increased production in 1956, storage inventories of practically all sizes at breaker sidings, tidewater and ground storage declined by about 520,000 tons which resulted in a total sales increase of over 2,000,000 tons for the industry as a whole.

The financial situation in the industry, particularly during the first four to six months, was still a continuance of low prices and dumping of the various companies' inventories; however, an unexpected late winter and a long cold spring used up the excess tonnage and the price structures of all sizes materially strengthened during the rest of the year, particularly during the last three to four months. The export market became an important factor during the middle of the year.

Exports Increase

The year 1956 marked a large increase in anthracite of all sizes for export. The total export figure is estimated at 2,600,000 tons of which approximately 500,000 tons were fines of No. 4 buckwheat and smaller. One of the main requirements of this relatively new market is the use and sales only of high quality coals. All coals are sold on an analytical basis with a careful check-up being made both at the piers and the overseas terminals. This tonnage represents an increase of almost 2,000,000 tons over the preceding year 1955.

Other Markets Developed

Aside from the all important and dominating weather factor in the use

of anthracite, other markets were being developed, particularly for the smaller sizes.

The large increase in the sintering plants of the steel industry has created an additional present and future demand for No. 5 buckwheat. Besides the use of this sinter coal, another market expanding in the steel industry is the use of pelletizing taconite ores. It is expected that the taconite market will expand to over 500,000 tons per year within the next five years. It is estimated that around 100,000 tons were sold to this market in 1956.

Increased production of coke and future production has created a market in the last few years using anthracite as a mixture with bituminous coal. Approximately 400,000 tons of anthracite were marketed for this use in 1956.

The chemical industry is becoming more alert to the use of anthracite as a source of carbon. The future of this market has not been fully exploited. It is estimated that about 400,000 tons of anthracite are being used for this type industry.

Production Control Plan

One of the important milestones of 1956 was the re-establishment of the Production Control Plan of the State of Pennsylvania through the acceptance by signatories of new allocations that will insure anthracite production being sufficient to meet market demands without excessive overproduction and the resultant waste of a valuable natural resource. This accomplishment exemplified the finest type of cooperation on the part of the Commonwealth of Pennsylvania, The United Mine Workers of America and anthracite operators. The new allocation section of the plan was accepted by the anthracite operators and came formally into existence on May 4, 1956. It has functioned properly since that date.

$500,000 for Research

Another step forward for the anthracite industry was the formation of the Coal Research Board of the Commonwealth of Pennsylvania with an appropriation of $500,000 for research on anthracite and bituminous coal. This program aims at increasing markets for coal through the development of new and improved uses by means of basic and applied research. Much of the research work will be conducted by Pennsylvania State University. However, the program will also include a survey of anthracite markets in Western Europe, a project which will be handled by the Anthracite Institute.

A successful Anthracite Conference was sponsored by Pennsylvania State University on October 18 and 19. Eight papers of importance to the industry were presented by competent authorities, including papers on the metallurgical uses of anthracite in blast furnace, foundry cupola and sintering operations.

Union Relations

A new wage agreement, the first since November 1, 1952, became effective on December 1, 1956. The agreement, providing for increases from $1.50 to $2 per day, also increased vacation pay and premium pay for Saturday, Sunday and holiday work. The package increase amounted to approximately $2.15 per day.

Anthracite Drainage Program

During the past year, great strides have been made in the organization and management of the Federal-State anthracite mine drainage program.

The Commonwealth has its deputy secretary of mines for anthracite in direct charge of the program. Under him is a chief engineer, two division engineers for the Northern-Southern Fields respectively and their staffs. The Federal Government has also established its organization directly under the Bureau of Mines with specific engineers for study and approval of all projects.

Pump projects have already been approved for two 5000 gpm pumps in the Northern Field and two 3000 gpm pumps in the Southern Field. Approximately eight more large abandoned mine pump installation projects are now under engineering study with a total capacity of over 100,000 gpm.

One large surface flood control drainage project in the Northern Field has been approved by the State and has been submitted to the U. S. Bureau of Mines for Federal approval. Five more surface projects have the colliery engineering completed and are now being checked by the State engineers for their final acceptance and readiness to forward to the Federal agency.

Cement

(Continued from page 61)

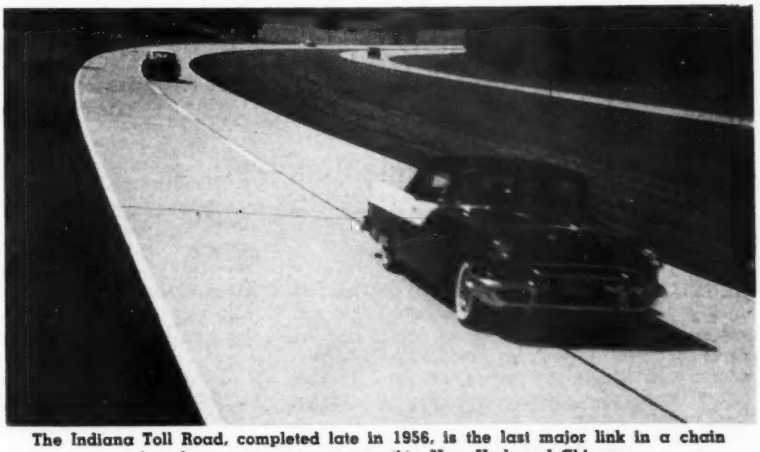
and huge shopping center parking areas in Houston, Tex., and Minneapolis, Minn.

Injury Severity—Number One Safety Problem

An all-time low injury-frequency rate of 2.66 injuries per million man-hours was set in 1955 by member company plants of the Portland Cement Association, which leads and coordinates the industry's safety program. The severity rate of 1372 days lost and charged per million man-hours has been bettered only in 1954.

Reports for the first nine months of 1956 show a slight increase in the number of disabling injuries per million man-hours, approximately six percent over the same period of 1955. Injury severity continues to be the number one safety problem.

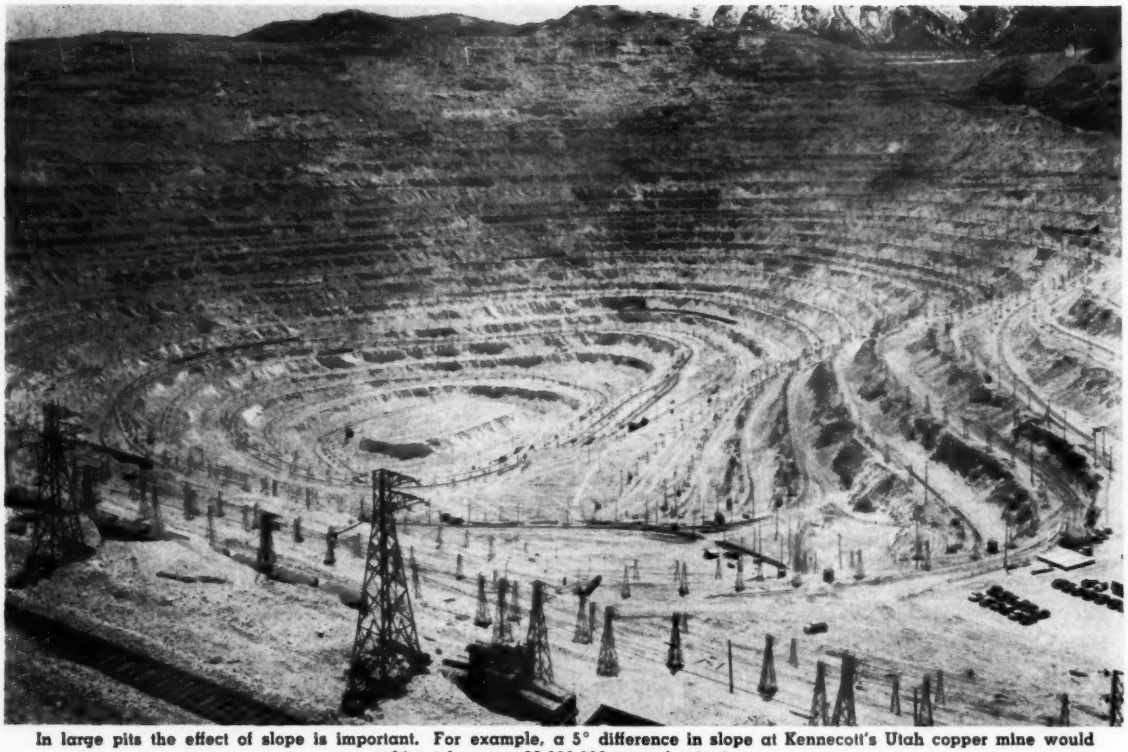
The association in 1955 won the National Safety Council's award for outstanding performance for the fourth time in five years.



The Indiana Toll Road, completed late in 1956, is the last major link in a chain of modern expressways connecting New York and Chicago

Outlook

The post war construction activity which has led to new records in cement production every year since 1947 is still continuing. Despite the drop in homebuilding and a generally tight credit situation, the dollar value of construction last year was up about a billion dollars from 1955 and is predicted to rise again in 1957. The physical volume of construction is holding steady. The current huge backlog of needed construction and our rapidly growing population, which will create even greater demand for construction in the future, point to a strong long-term demand for cement.



In large pits the effect of slope is important. For example, a 5° difference in slope at Kennecott's Utah copper mine would ultimately mean 80,000,000 tons of stripping

Open Pit Mining

Important trends and developments in methods and equipment during the past year are reviewed

By ADOLPH SODERBERG
Consulting Mining Engineer
Kennecott Copper Corp.

ADOLPH SODERBERG, a graduate of the University of Utah, started his mining career with Utah Copper Co. at Bingham Canyon in 1923. Many years of outstanding performance as engineer of mines in the Utah organization made him a natural choice to become Consulting mining engineer on the staff of the Western Mining Divisions of Kennecott Copper Corp. He has had broad experience in all phases of open pit engineering including major layouts, engineering studies, and evaluations on many operating projects throughout the west, in Canada and in Africa.

DEVELOPMENTS in open pit mining during 1956 were indicative of the rapidity with which the industry converts to new techniques and both adopts and adapts new equipment to effect improved efficiency and reduction in production costs. This progressiveness on the part of operator and manufacturer has led to the successful exploitation of orebodies that would otherwise have remained undeveloped, particularly the smaller open pits that have come into being in recent years. Many are in residual ore areas left in old underground mines.

For many years open pit mining was limited to orebodies large enough to amortize the high cost of rail haulage systems. Development of the modern off-highway truck with torque converter and great improvement in rubber tires was the important single development that made the small pit operation possible. It finds its place, too, in areas of large rail pit operations where flexibility and maneuverability are a necessity, or where short hauls to waste dump areas are possible. In some rail pits the truck is used in conjunction with drop-cutting operations as levels are opened up at depth. In a southwest pit operation a combination truck and rail haul is used in waste haulage. Here the maximum economical truck haul is considered to be about 3000 ft. A loading ramp is provided at the pit lip elevation for dumping in railroad dump cars and trains of ten cars are hauled approximately one mile to the dump with a diesel electric locomotive.

In another pit, trucks are used for haulage distances up to 1½ miles (one way) but consideration is being given to transferring to rail haulage as the

distance to the dump increases toward its ultimate of three to four miles. Another southwest copper pit, however, uses trucks to haul ore $4\frac{1}{2}$ miles from pit to mill. These local variations are apparently dictated by the tonnages involved as related to possible alternative methods.

At the larger open pits where transporting distances are on the order of two to seven miles and more, and daily tonnage of ore and waste are in the range of 100,000 to 270,000 tons, rail haulage with trolley-electric or diesel-electric locomotives is still the most economical method. Diesel-electric locomotives have the advantage of eliminating trolley towers within the pit working area and on the waste dumps where constant track shifting requires moving of trolley lines. Trolley electrics have offsetting advantages of lower maintenance costs and where power rates are favorable, lower power costs.

Transportation by belt conveyors and skips, common practice in the iron ore pits, is now receiving considerable attention by the copper mining industry. The first skip installation in a copper pit is being completed by Pima Mining Co. at its new pit southwest of Tucson, Ariz. Conveyors and skips are particularly attractive where haulage against high lifts is encountered. Skips can be operated on pit slopes from 25° to 45°, but belt conveyors can be installed only where slopes do not exceed 18°. Conveyors are also limited to crushed material which, in the case of ore, works out very well, but is a needless expense for waste. Each type of transportation has its application, and reports from operators indicate that all known ideas are constantly being evaluated for each particular problem.

Trends in Equipment

Increased mobility and larger units highlight the year's new equipment developments. The trend continued to rubber tired units to replace crawlers, particularly for dozers and mobile drill units.

The mobile drill unit mounted on a crawler tractor for toe hole and secondary blasting was pioneered at the Bingham Canyon pit a few years ago. Since then a number of such units have been introduced by several manufacturers. This past year saw the interesting development of mounting a drilling unit on a standard rubber-tired logging tractor with four-wheel drive and four-wheel steering. The unit was engineered and built from standard components at the mine shops at Kennecott's Chino pit at Santa Rita, N. M.

A four-in. drifter with ten-ft carriage is mounted on an extendable hydraulic drill jib with ten-ft boom and five-ft hydraulic extension on the front end of the tractor. The tractor is powered with 115-hp diesel engine. Drilling air is supplied by a 315-cu ft rotary compressor mounted over the rear wheels of the tractor.

The trend towards replacement of churn drills with rotaries continued at an accelerated rate during the year and nearly all pits drilling vertical blast holes are now using them. Typical of the trend is a western pit that a year ago had one rotary drill and now has three. Starting with 7-in. and 9-in. hole sizes when first introduced, units drilling 12-in. holes are now performing quite well, with considerable savings particularly in drill bit wear per unit of blasting hole volume.

A smaller but more mobile rotary drill was introduced during the year. It is mounted on a 75-hp crawler tractor and uses the tractor motor to drive the rotating and feed mechanisms and the compressor. The mast is lowered and raised hydraulically to add to its mobility. This makes it well adapted to pit pioneering work and for long moves to short jobs as compared to heavier and more cumbersome machines. Experience of one operator indicates it can drill a nine-in. hole of about double the rate of a 29-T churn drill. It does not compete with the larger units in production drilling on level benches.

Several tire manufacturers are producing a tubeless tire, with extra deep tread, which preliminary testing indicates will give about 50 percent more tire life at about a 15 percent increase in tire prices.

One operator reports the addition of a turbo-charger adds about 25 hp to a 200-hp engine and 35 hp to a 300-hp engine. Their trucks have also been equipped with torqmatic braking systems which have increased the life of brakes and is a valuable safety feature in downhill load hauls.

Rear dump trailed load units are also proving successful because of excellent maneuverability in tight spots. Single, large section diameter tires, instead of dual tires, are reported by one operator as giving better tire wear. Hauling speed of the unit, however, is limited by a tendency to "gallop." To eliminate this, a double axle construction has been introduced, but this results in loss of traction. To increase traction an experiment is being conducted by using what is known as the "Mississippi weight transfer," which shifts more weight onto the traction wheels of the unit.

The trend continued to rubber tired units to replace crawlers, particularly for dozers and mobile drill units

Rubber tired, self-loading tractor scrapers are being used in stripping operations in alluvium at Boron, Calif., and at Pima, Ariz.

Truck Haulage

For short hauls, trucks continue to be the workhorse with a trend toward the larger units of 35 tons and 50 tons. Some still prefer the 20 to 25-ton unit, but one operator has "beefed" up such a unit in his own shops to haul loads of 35 tons.

One mine reports tests being made on a 36-ton truck equipped with a single 400-hp engine and a single rear axle. It is anticipated maintenance costs will be less than for the common two motored and double rear axle units. A 34-ton truck introduced by one manufacturer is driven by a single 400-hp motor and a power divider utilizing two rear axles.

Track Shifters

Two track shifting methods on dumps are of particular interest. One is a combined track shifter and dump plough or spreader developed in Germany. A moving picture film of this was shown at the recent American Mining Congress meeting in Los Angeles. The machine operates on rails either as a self-propelled unit or it can be pulled by a locomotive. It consists of spreading blades, similar to a Jordan spreader, so arranged and operated to push dumped material out over the crest of the dump, and to prepare a grade preparatory to shifting the tracks out towards the edge of

This 38° skipway at the Pima mine, the first skip installation in a copper pit, will have a capacity of 1300 tph from the 280-ft level and 1000 tph from the 600-ft level

the dump. The track shifting device consists of a head of horizontal rollers clamped along the side of the rail heads of the two track rails and so operated that when the machine moves along, the track is shifted laterally as a unit for a distance of about 18 in.

Several units are working in the Rhenish brown coal area where the overburden appears to be fairly free of rock. Another is in operation at the Katanga open pit mine where the waste dumps are broken rock. It appears to have interesting possibilities, particularly on long dumps.

Another interesting method has been developed at one of the southwest copper pits. Shifting of track on the dump is done by a crawler type excavator working at right angles to and off the track. It is equipped with an attachment designed to be hooked onto the inside edge of the inner track rail which is then raised and pulled back from the crest of the dump. A grade is then prepared with a dozer or patrol after which the track shifter attachment hooks onto the inner edge of the outside rail and the track pushed back out to the edge of the dump on the prepared grade. No ballast is used, the track being left open at all times. This unit has reduced the dump crew from 20 to 8 men.

Blasting

Use of fertilizer grade ammonium nitrate plus carbon in a variety of forms is expanding tremendously for primary blasting and in many mines has passed the experimental stage. The latest development is the use of "prilled" ammonium nitrate, which is granular, with the carbon added during loading operations in the form of fuel or diesel oil. At a western copper pit the prilled ammonium nitrate is dumped into the drill hole and fuel oil added by pouring into the hole. At another operation the fuel oil is added by pouring on top of the ammonium nitrate while in the bag prior to loading. About ½ gal of oil is added to an 80-lb bag. The oil readily permeates the nitrate and no mixing is required. This apparently also happens when the fuel oil is poured onto the ammonium nitrate dumped loose into a drill hole. Savings in powder costs are on the order of 50 percent over the use of gelatin and semi-gelatin powders.

Experiments are being conducted with millisecond primacord delays in both single and multiple row shots. Results indicate better fragmentation, particularly in the harder, more fractured pit areas.

A report has also been received that time for loading toe holes has been cut almost in half by the use of 2 by 12-in. sticks of powder and two-in. plastic loading tubes in place of the 1⅛ by 8-in. sticks and 1¼-in. tubes.

Maintenance

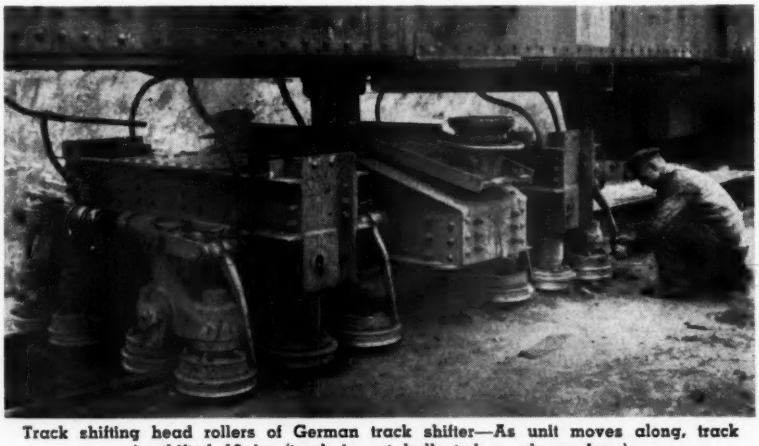
Preventative maintenance is fast becoming the rule at most pits. Operators have learned that systematic inspection and regular trips to the shop at fixed hour intervals pays off in increased availability of equipment. A Canadian mine employs a punch card system of records to aid their preventative maintenance program. A permanent coded record of all repairs is made on punch cards of all pertinent data. Included is such information as truck number, operator's number, pit supervision, repair shop supervision, the mechanics making the repair and the repair itself. The data is used to establish an hour-life value for each part and to point out repetition, abuses, duplication, improper work and inferior parts. A western operator brings trucks in at 500-hr intervals for thorough inspection, checked against a maintenance check list. Also listed are the parts to be inspected at 1000, 2000 and 3000-hr intervals.

Slope Stability Studies

The possibility of more accuracy in predetermining safe ultimate pit slopes has been studied during the past year. Working slopes ordinarily are of little concern because berm widths and bench heights to provide maximum economical operation are such that the resulting over-all slopes are so flat there is little possibility of failure involving more than one level. A pit with benches 50 ft high, berm width of 75 ft and bank slope of ½ (horizontal) to 1 (vertical) will have an over-all slope of 2 to 1 or about 26°. At a 1 to 1 bank slope the over-all slope becomes 2.5 to 1, less than 22°. Projected ultimate slopes in most pits range from 1.4 to 1 (35°) to as much as 1 to 1.5 (56°). The smaller pits are predominantly designed to a 1 to 1 (45°) slope and the larger pits to 1.2 to 1 (40°) as a maximum. Choice of the ultimate slope is made largely by experience, taking into consideration rock structure, geology, faults, etc. In the last analysis, however, it is really a cut and try method with a record of general acceptable performance but without assurance that maximum economy in stripping ratio has been achieved.

In pits where the ultimate height is in the range of 400 to 500 ft, a few degrees difference in the final slope may not be too serious in its effect on the over-all stripping ratio and tonnages of recoverable ore. However, in pits with ultimate heights of 1000,

(Continued on page 164)



Track shifting head rollers of German track shifter—As unit moves along, track is shifted 18 in. (track is not ballasted as shown here)

View of storage and stripping department, Federated Metals Division, American Smelting & Refining Co., San Francisco, Calif., showing solder in 50-lb spools and margach linotype stacked in piles

Lead and Zinc

Outlook appears to be for a continuance of the firm, stable markets which prevailed in both metals during 1956

By CHARLES R. INCE
Vice-President and Sales Manager
St. Joseph Lead Co.

CHARLES R. INCE attended Columbia College and Columbia School of Mines. From 1926 to 1929 he served as a lecturer in mining at the Columbia School of Mines. Transfering to the Sales department, St. Joseph Lead Co., in 1929, he attained the position of sales manager in 1948 and became vice-president and sales manager in 1950.

THE lead and zinc industries in 1956 were featured by extremely stable markets, lower consumption than the previous year and large surpluses of both metals. The apparent anomaly of stable markets in the face of mounting surpluses is easily explained. Government domestic stockpiling and purchases abroad through the barter program—whereunder U. S. agricultural commodities are traded for strategic materials of foreign origin—removed the surpluses from the world markets as they developed and eliminated pressure on the prices which ordinarily would arise from the liquidation of the excess in the U. S. market. Lead held firm throughout the year at 16c per lb and zinc maintained the 13.5c level to which it had been raised early in January.

Despite a rise in the Federal Reserve Board Index of Industrial Production to a new high of 143, consumption of both metals fell below the previous year due mainly to the drop in production of consumer durable commodities. Of the two metals lead appears to have been the strongest statistically throughout the year, as can be seen from the table on supply and consumption of both metals.

Lead Markets Tied to Automobile Sales and Use

Lead, which declined to a lesser extent than zinc, was cushioned by an increase in the use of the metal for tetraethyl fluid. This comparatively new application is the second largest outlet for lead and accounted for an increase of 20,000 tons. The rate of growth of this industry may be slowed due to the expansion of catalytic cracking and reforming facilities which raises the octane rating of the base stock of gasoline. Furthermore, the recent completion of a tetraethyl plant in Canada, with a capacity of 7500 tons of lead a year, will mean a loss of that much of the export market by the American producers. Offsetting these adverse factors is the increasing demand for higher octane gasoline as the compression ratios of automobile engines are raised. The introduction of super-special gasoline by three oil companies has resulted in a revision of the octane index and now a rating of 105 is not considered abnormal, whereas previous highs were in the 95-98 range. The increment supplied to the base stock by tetraethyl lead appears to be essential and there is no indication of a diminution in the trend to higher octane gasoline. Evidence of this and the faith of T.E.L. manufacturers in the future of their product lies in the fact that a new plant has just been completed in California and two more are planned in this

COMPARISON OF DOMESTIC LEAD & ZINC SITUATION—1955-1956*

	Lead 1956 (Tons)	Percent Change		Zinc 1956 (Tons)	Percent Change
Consumption	1,170,000	— 3.5	Consumption	970,000	—10.6
Supply					
Mine Production	350,000	+ 4.0	U. S. Primary & Secondary Production	1,057,000	+ 2.5
Imports (net)	436,000	.0	Metal Imports (net)	222,000	+24.7
Secondary Production	500,000	.0			
	1,286,000			1,279,000	+ 5.8
Surplus	116,000		Surplus	309,000	
Consumption by Industries					
Tetraethyl Lead	185,000	+12.0	Consumption by Industries		
			Galvanizing	416,000	— 5.3
Storage Batteries	355,000	— 6.4	Die Casting & Zinc-Base Alloys	337,000	—16.8
Cable Covering	134,000	+10.6	Brass Products	126,000	—13.2
Construction	118,000	— .6	Rolled Zinc	46,000	— 8.3
Pigments	114,000	—10.3	Oxide Plants and Others	45,000	— 1.0
Solder	71,000	—19.3			
Ammunition	44,000	— 3.9			
All Other Uses	149,000	— 6.6			
Total	1,170,000	— 3.5	Total	970,000	—10.6

* Last quarter of 1956 estimated.

country—one in the Middle West and another one on the West Coast.

The major use of lead continues to be in storage batteries which declined during the past year due to a drop of 25 percent in new car production and a reduction in replacement battery shipments (further evidence of the increased life of batteries). The third largest use of lead, as a protective sheathing on cable, registered an increase of 13,000 tons in consumption. This reflects the greater demands of the power cable industry which established a new high of power distribution of 12 billion kwh, some 15 percent above the previous year's average. During the coming year the prospects are that lead will just about maintain its 1956 rate of consumption, somewhere between the 1,150,000 and 1,200,000 ton range. The decline in tetraethyl use will be offset by an increase in batteries due to higher car production and a rise in automotive registrations, while other lead uses will continue at about the same rate.

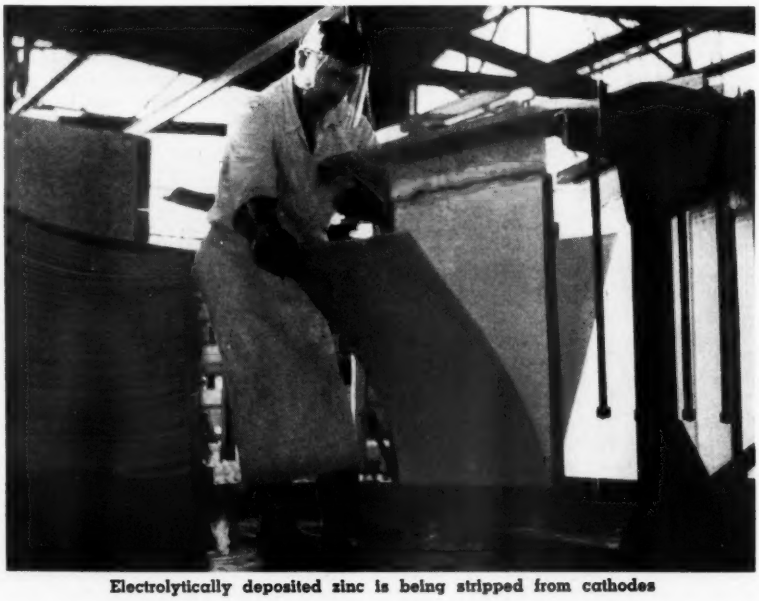
Zinc Prospects Good

Zinc consumption in 1956 suffered mainly from the decline in die casting and brass industries. The former, which ships about 60 percent of its zinc-base product to the automotive industry, reflected the reduction in car production, while the latter was adversely affected by the uncertain copper situation as well as the lower rate of activity in the automotive field. Galvanizing, the largest use of zinc, accounted for about 416,000 tons, a slight easing of 5 percent from the previous year. This does not tell the whole story as the decline was entirely in miscellaneous forms of galvanizing since sheet and strip galvanizing registered a gain. This is further evidence of the marketability of the product of the relatively new continuous line galvanizing process. Thirty-four of these units were in operation at the end of the year compared to 26 the previous year. Despite the interruption of a month to six weeks in production due to the steel strike, shipments of galvanized sheet were running 5 percent higher through the first ten months than 1955 and had already established a new high in monthly shipments for the industry. With predictions of a continued high rate of steel output and the expected increase in automotive production which will of course benefit die casters, the zinc industry might anticipate an increase in consumption to at least 1,000,000 tons in 1957.

Government Stockpiling

On the supply side of the picture, the imports of lead and zinc in the form of ore and metal continue to exceed production from domestic sources. Mine output showed a slight gain over the previous year's figures due mainly to the fact that there were no work stoppages as occurred in 1955. It is becoming increasingly evident that Government stockpiling is not accomplishing its avowed purpose of "maintaining an adequate mobilization base" in the domestic mining industry. The program has appeared to benefit foreign producers more than domestic miners. The domestic lead producers and consumers therefore await the presentation to Congress of the long-term mineral program of the Administration which has been promised for early 1957.

However, as long as the U. S. Government continues to absorb the surpluses that arise from over-production abroad there should be no threat to our domestic markets. At the year's end there was every indication that not only domestic stockpiling would be continued in 1957 as a result of the recent upward revision of the long-term stockpile goals for lead and zinc, but also that the Department of Agriculture would continue its acquisition of the metals from foreign sources for the supplemental stockpile. Under the circumstances, the prospect appears to be for a continuance of the firm stable markets which prevailed in both metals during the past year with the possibility of some improvement in lead due to its stronger statistical position and the pressure of rising costs of production.



Electrolytically deposited zinc is being stripped from cathodes

Mechanical Coal Mining in '56

Increased mechanization led to a 95-percent increase in productivity during past 10 years. New machines and further refinements promise to keep trend going. Special interest is being shown in a-c developments and an a-c shuttle car was put on the market during the year

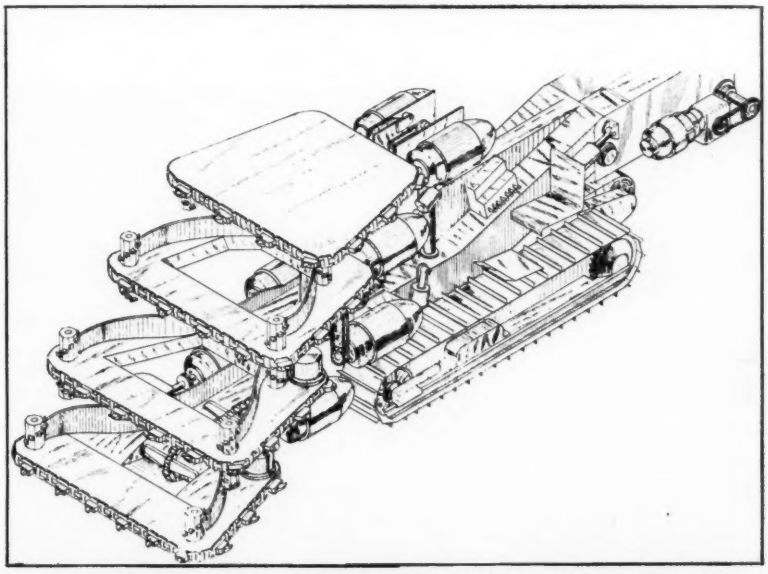
By F. R. ZACHAR
Consulting Engineer
Pittsburgh Consolidation Coal Co.

FRANK R. ZACHAR went to work for Pittsburgh Coal Co. as a mining and preparation engineer in 1937. In 1940 he joined Koppers Coal Co. as a mining engineer. From 1944 to 1948 he was with Hanna Coal Co. as a mine superintendent and from 1948 to 1955 was general superintendent of Christopher Coal Co., a subsidiary of Pittsburgh Consolidation Coal Co. He left that position to do consulting work in connection with Pittsburgh Consol's expansion program in northern West Virginia.

PRODUCTION loaded mechanically from underground bituminous mines in the United States reached new all time high in 1956. This statement tells the story of the re-vitalized coal industry that exists today.

During the past decade we have watched the coal industry produce the all time high of 631,000,000 tons in 1947 and the discouraging low of 392,000,000 tons in 1954. This low climaxed a long period of readjustment and proved to be the turning point in coal's rapidly dropping production curve, and with the 470,000,000 tons of 1955 and the estimated 504,000,000 tons of 1956 as stepping stones, it is a strong possibility that bituminous coal is on its way to the magical "billion ton year."

The remarkable changes of policy that have brought about the stability and productivity placing the formerly floundering coal industry of only a few years ago in the number position among our most modern and progressive industries have been the results of concerted efforts on the part of labor and management and appreciation of these efforts by consumers.



One manufacturer plans to introduce a continuous mining machine in 1957 which utilizes cutter bars and a wedging action to break down the coal

The cost of stability has been high, with the labor cost, including fringe benefits, per man day more than doubling since 1947 and the sales price at the mine being held down to the 1947-1948 levels. To be able to afford the cost of stability, management has had to devise ways and means of increasing productvity.

The year 1956 undoubtedly continued the upward trend in productivity for underground mines and probably reached 10.6 or more tons per man day.

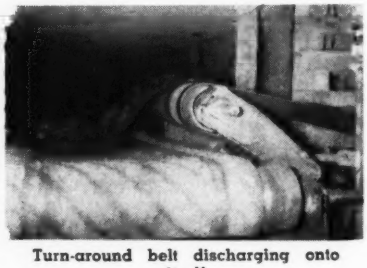
This increase in productivity (almost 95 percent in the past ten years) has been brought about almost entirely by increased mechanization. In 1956, mechanically loaded production was about 87.5 percent of total underground production, a new high for the industry. This is a continuation of the trend that has made the bituminous coal producers of America the most efficient coal producers of the world and which has enabled the industry to achieve it's present sound position.

Probably no other industry has such a variety of conditions under which the product of that industry must be produced. No two seams are exactly alike, no two mines have the same conditions, and more often than not, operating sections within individual mines will differ to some degree. Consequently, mechanization of the bituminous coal industry is not a one time problem but one that requires and will require the continued efforts of management and equipment manufacturers to bring about machinery that, coupled with trained operating personnel, will increase productivity in the mines to the one day expected 20 tons per man day.

In 1956, more and more operations, realizing that their industry was on a definitely assured upswing, and taking stock of the necessity of continued improvements in their own mines, made additional demands on equipment manufacturers, adopted or expanded personnel training programs, and increased the application of industrial engineering practices.

Continuous Mining

During the year the economic pressures brought on by increased labor costs and increased costs of operating and maintenance supplies, augmented the industry's demands for higher capacity production tools. Consequently, the sales of continuous mining equipment rose considerably and the number of machines in service increased greatly from the 430 or so in use in 1955. Manufacturers of



Turn-around belt discharging onto itself

continuous mining equipment rose to the occasion and in the most part were able to meet demand and delivery schedules. The manufacturer of a rotary oscillating type machine reports a 200-percent increase in sales and it is indicated that boring and ripper type machine manufacturers will also report substantial increases also.

The offering to the industry of a low cost auger type machine with a mining range of 26 to 41 in. received considerable attention in 1956 and in many cases, offered the opportunity for continuous mining to many at lower than usual capital investment.

Considerable interest has been aroused in the patenting and engineering of a "cutter bar and wedge" type machine to be manufactured in 1957. The manufacturer of this machine holds high hopes for its ability to produce at a high rate with low maintenance costs and with the production of a minimum of fines.

As might be expected, operators in thinner seams are increasing the tempo of their demands for equipment that will mine their seams at a production rate considerably higher than realized to date. Consequently, the pressure was put on the equipment manufacturers to alter present

Continuous mining machines were made lower

designs or offer new designs to meet these demands. It is to the credit of the manufacturers that we can report tremendous efforts on their part to satisfy the requirements of their customers, the coal industry. One manufacturer is developing two types of machines with an over-all height of only 24 in. for 30-in. seams. In addition to higher capacity, these machines are reported to employ a newly applied principle of removing coal from the face. This same manufacturer has also developed a 4.5 ton per minute machine only 32 in. high but with a mining range of from 38 to 81 in. A new low cost rotary oscillating type machine only 26 in. high and capable of mining 30-in. to 48-in. seams was tested in 1956 and will make its production debut early in 1957. A third manufacturer reports continued developments of an extremely low height, high capacity, multiple arm boring machine that is expected to meet the requirements of many operators.

In the machines for higher seams, manufacturers are redesigning and improving present designs, putting special emphasis on increasing mining ranges and providing the necessary horsepower for high capacity production. The manufacturer of a multiple arm boring machine has increased mining ranges providing either 67 to 88 in. or 75 to 96 in. with a mining width increased to 10 ft. 10 in. In 1956, this machine found considerable success in very hard cutting with slower arm rotating speeds.

Manufacturers, in their redesigns, have made many improvements that should lower the maintenance costs of continuous mining. Unit replacement has been given considerable attention in design and several changes have been made permitting unit replacement of electrical components on the machines.

One of the recognized short comings of continuous mining has been the limited ability to remove coal with existing transportation devices as fast as it could be produced. In 1956, several devices proved themselves as at least an important step in the right direction toward diminishing this problem. Extensible belts have proven themselves and the trend in thinking seems to be away from conventional belt installations at the face and toward light weight extensible units, with one manufacturer reporting 80 in use at the end of 1956. Another manufacturer has experienced initial successes with a rope type extensible belt and anticipates additional acceptance in the industry.

Sixty percent of the continuous mining machines sold in 1956 had roof drills attached

The development of extensible belts in 36 in. widths has added impetus to their acceptance and successful application.

One of the most startling developments in belt transportation during 1956 was the belt conveyor that turns 90° corners. This unit was developed by an operating company and its development is indicative of the intense interest in improving transportation facilities at the face.

Additional interest has been shown in so-called "piggy-back" conveying systems, particularly in thinner seams, and quite a few additional units of this type were installed during the year.

The industry has shown a gaining interest in laterally flexible continuous conveying systems and manufacturers and operators together are working on the problem. The trend in thinking seems to be that the shuttle car behind the continuous miner does not permit the usage of full production time and the search for more efficient transportation mediums has been intensified.

The practice of roof bolting with drills mounted on continuous mining machines had been successfully proven earlier, but in 1956 came into its own. It is estimated that about six out of ten machines sold in 1956 were equipped with roof bolting drills attached. This is a further step in bringing about uninterrupted face production by the miners and a further step toward making the term "continuous" an actuality.

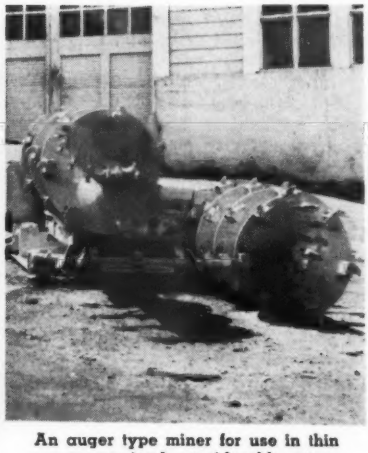
Addition work was done in developing successful wet rock dusting techniques that will permit on shift application and uninterrupted production.

It can definitely be said that 1956 produced many developments in machinery and operating practices that will have contributed greatly to the science of continuous mining when the improved productivity of future years is realized.

Continuous Mining Systems

In the past it has too often been the practice of mine operating officials to purchase continuous mining machines and then put them to work in the mine in an existing section by merely replacing conventional units and doing little or nothing to change the mining system to permit full advantage of the new equipment. The fallacy of this was recognized early in the history of continuous mining but not enough was done to correct it. It is most encouraging to report that the year 1956 was one in which many more operators began or intensified their investigations as to just what mining systems best suited their particular conditions. Many mines have improved continuous mining productivity by altering mining systems and industry-wide studies of this subject are receiving intense interest.

Rope type extensible belt was introduced during year. Shown are rope terminal posts belted to roof



An auger type miner for use in thin seams received considerable attention during the year

Conventional Mining

There has been considerable work done on the problem of providing high capacity loading machines for lower seams. Several manufacturers have come out with crawler mounted machines for 36 to 42-in. seams with 8 to 10 tons per minute loading capacity. For higher coals, one manufacturer has redesigned a machine to provide the same high capacity in a 42-in. machine as formerly in a 51-in. machine.

Shuttle cars received considerable attention during 1956 with design being changed to present more rugged and more powerful equipment for normal usage as well as for those mines having rough terrain, pitches, etc. It is believed that much progress has been made to curtail the objectionable down time of shuttle cars by these improvements. One new shuttle car, employing a constant speed electric motor and torque converter, was marketed in 1956 and indications are that initial results are encouraging.

The a-c powered shuttle car, long needed, was developed by several manufacturers in 1956. This accomplishment rounded out the complement of a-c equipment available and opens new avenues for a-c mine power systems both in conventional and continuous mining fields.

Cutting machine sales indicate a definite trend away from shortwall machines and increased application of universal machines. One new 26-in. universal machine of high capacity is now offered as a shortwall replacement. Probably the most significant development in cutting machines during the year was the accelerated trend toward the application of bug-dusters on universal machines where such machines are used for bottom cutting.

Higher capacity rubber tire

Refinements were made on many machines, increasing their mining ranges and productivity

mounted coal drills have continued to replace hand held drills and excellent equipment is now available for use in thinner seams. Of definite significance is the development of light weight hydraulic hand held drills. These units have proven their worth and manufacturers report a rapidly growing interest in these units.

Considerable progress has also been made by equipment manufacturers in developing auxiliary equipment, both for conventional mining and continuous mining, for thin seams. Roof bolting machines have been greatly improved. The scope of the rubber tire mounted rotary drill has been expanded and machines that drill at any angle or have multiple booms are now available. Wider choice of rotation speed and torque as well as a wider range of run up and retraction speeds are now available in these units. New developments in dust collection have increased productivity of stoper units. Also, stoper units with extremely low over-all height and multiple booms of wider range have increased the efficiency of roof bolting considerably.

Space does not permit a complete summary of improved and new equipment developed and offered in 1956, but a review of the advertisements and articles appearing in the year's trade journals, should furnish the reader with a better picture of what has been accomplished and will verify that 1956 has been one of coal mining machinery's more progressive years.

Alternating Current Mine Power

While a-c has been in use in underground mining for some time, it is believed that the underground bituminous mining industry really accepted a-c in 1956. At least one very large new mine, engineered in 1956, has specified a-c and manufacturers report a very definite trend in the thinking of operators contemplating equipment for new mines toward a-c. One very significant contribution of 1956 was the development of a heretofore unavailable a-c shuttle car

Improved dry type transformer banks of 300-kva capacity but weighing only 7000 or less pounds have proven successful and additional, almost fool-proof safety devices, are now offered. Sectionalized cables have been improved and improved permissible attachable connectors are available.

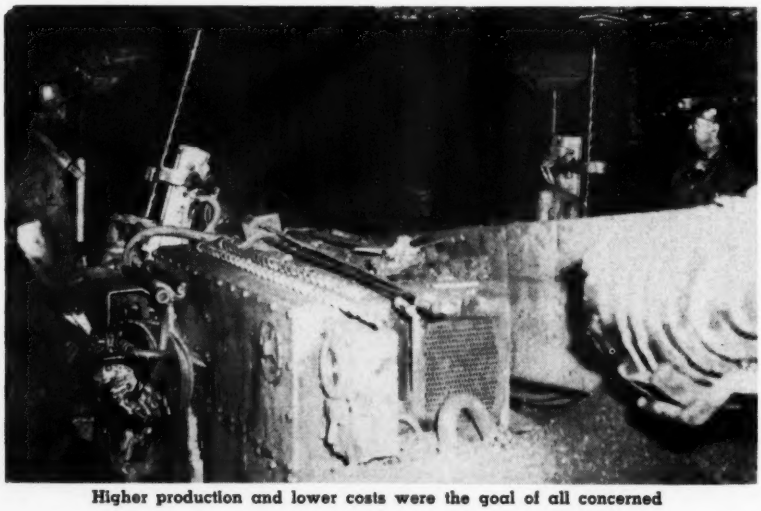
It is anticipated that additional successes with a-c underground equipment of lower first cost and lower maintenance costs achieved with a-c will promote further interest and many more installations in the future.

Industrial Engineering and Personnel Training

With the average labor cost per man day, including fringe benefits and indirect payments, rising to approximately $28.00 in April 1956 and to $29.40 in October and a $30.20 man day coming in April 1957, the industry is becoming more and more aware of the need to profitably utilize every available minute of the production day.

When the mine operator whose mine is producing at the so-called average rate of 10.3 tons per man day and showing an approximate net profit of about $0.30 per ton considers the fact that if he does not increase his productivity, his April 1957 cost of labor will rise almost $0.80 per ton with anticipated profits dropping almost 27 percent, he must intensify his analysis of his equipment and production methods.

Industrial engineering, as such, has not been accepted in the coal industry as widely as in other basic industries, but the rising labor and supply costs of recent years have indicated that more than day to day observation of systems and methods by busy mine officials might be necessary if productivity at the mine is to keep pace with rising costs. The industry, in general, even though not adopting industrial engineering at any great rate, seems to have finally realized that industrial engineering is an effective tool in lowering production costs.



Higher production and lower costs were the goal of all concerned

The face transportation bottleneck was broken

In 1956 the bituminous coal industry produced slightly over 503,000,000 tons with about 220,000 men as compared to 600,000,000 tons with twice that many men only eight years ago. During coal's re-adjustment period many marginal mines were closed and many mines were forced to cut back their payroll in order to stay alive. During the past several years, more and more companies have begun to take stock of their personnel inventory and have introduced more scientific methods of ability evaluation in order to better place the right man on the right job. When the fact that the investment cost to create one job in a new mechanized mine today is nearly $25,000, as compared to $10,000 eight years ago, it is clearly understandable why today's mine operator is desirous of obtaining the most willing and most competent services for his labor dollar.

General

In retrospect, it can be truly said that 1956 was a year which offered nothing but encouragement and progress to mechanical production in the underground bituminous coal industry. The team of management, labor, consumer, and equipment manufacturer, combined forces to produce results that permit only optimism for the years to come and that the science of removing coal from the face underground is well on its way to taking its place among the more developed of our nation's major industries.

For wet concentration and magnetic recovery,

JEFFREY DRUM-TYPE SEPARATORS

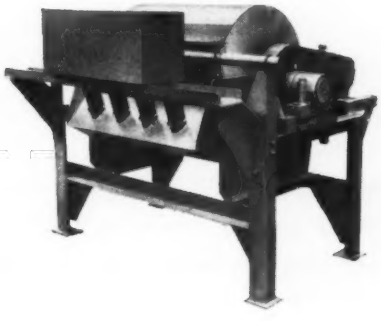
Extremely Simple: The drum is the only moving part and there are no slip rings or contact brushes. An entire plant can be handled by one man.

Highly Efficient: Close clearance between magnet poles and drum result in very little magnetic loss. Alnico permanent magnets can often be substituted for electromagnets.

Easily Adjusted: Intensity and depth of magnetic field can be suited to various separation problems by mechanical and electrical adjustments.

Finishing Type Separator

Provides a strong, positive washing action, since materials washed from the drum go back into the feed well for re-separation. Double or triple-drum counterflow finishing separators can be adjusted to deliver a middling product clean and substantially free of tailings and concentrate particles.

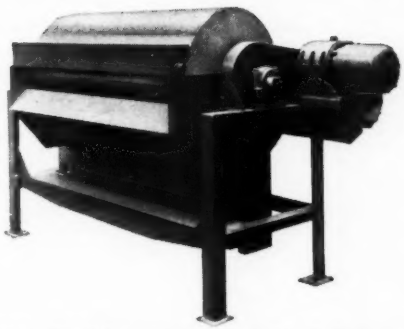


Type CO Separator

This counterflow overflow type was designed for the recovery of magnetic medium in a standard heavy-media plant. Compact, it saves floor space and headroom. Has extremely high capacity both from a pulp volume and magnetic solid carrying-capacity standpoint and also produces tailings extremely low in magnetics.

Type CS Separator

The spigot design differs from the Type CO in that a spigot discharge is provided for the relatively coarse particles. It is designed for use in fine ore treatment plants, where it is necessary to pass the sink and float products through magnetic separators, instead of relying upon drainage screens to remove the medium from these products.



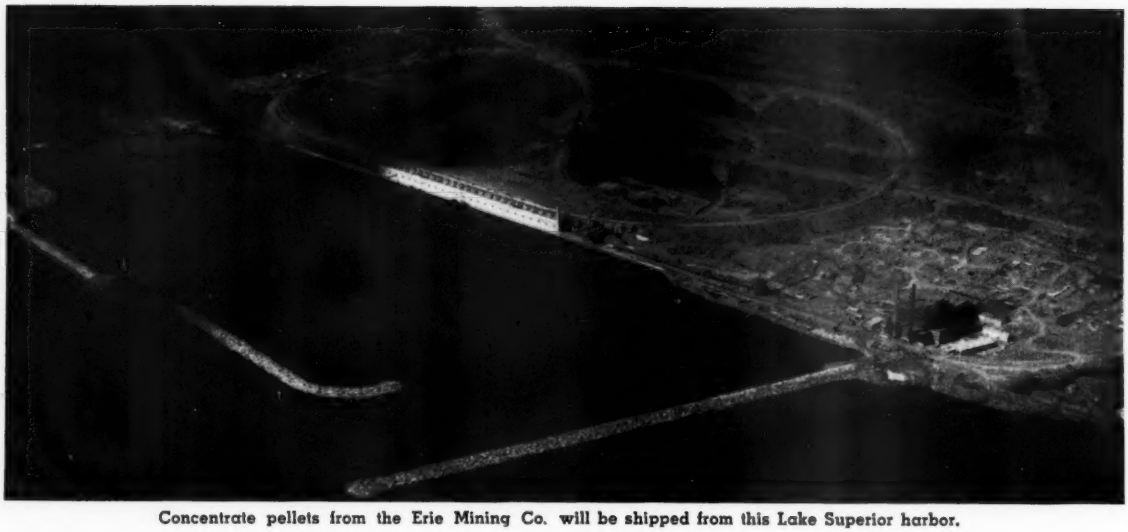
Type C Magnetic Cobber

A high intensity unit for producing tailings of lowest possible magnetic iron content. Eliminates barren gangue in coarse sizes, thereby cutting grinding costs; lowers plant tailings.

Export Division
THE JEFFREY MANUFACTURING COMPANY
Columbus 16, Ohio, U. S. A.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT • TRANSMISSION MACHINERY • CONTRACT MANUFACTURING



Concentrate pellets from the Erie Mining Co. will be shipped from this Lake Superior harbor.

Iron Ore

Predicted major expansion of ore supply became a full reality in 1956 with taconite concentrates from the Lake Superior region being added to the already established new supplies from Venezuela and Quebec-Labrador.

By CHARLES S. ARMS
Pickards Mather & Co.

CHARLES S. ARMS was graduated from Yale University in 1937 and went right to work in the iron ore mining business, serving as an engineer's helper in mines of the Lake Superior district. In 1939 he was employed by the Interlake Iron Corp. working on the blast furnaces at that company's Toledo plant. Since 1941 he has worked in various capacities at the main office of Pickands Mather & Co. in Cleveland where he is now head of the ore mining department.

PERHAPS of greatest importance in the records of iron ore for 1956 is the substantial fulfillment of the long-predicted major new sources of ore. For the first half of the current century, over 80 percent of all of the iron ore consumed in the United States came from the direct shipping iron ores and simple water concentrates produced from the great Lake Superior district. Substantially all of the remaining ore came from other areas in the United States. At about mid-century, it was predicted that three major new sources of ore would supply substantial tonnages and that there could be expected about 10,000,000 tons from the new Quebec-Labrador iron ore deposits, another 10,000,000 tons from Venezuela and around 10,000,000 tons of very high-grade taconite concentrates produced from the low-grade iron formations of the Lake Superior area.

The prediction as to Quebec-Labrador was more than fulfilled during 1956, when over 12,000,000 tons of iron ore were shipped from Seven Islands. The shipments in 1956 from Venezuela were close to 11,000,000 tons, with about 8,000,000 tons coming from the Cerro Bolivar Mine of the Orinoco Mining Company and the balance from Bethlehem Steel Company's El Pao deposits.

Taconite Production

Shipments of taconite concentrates from the Lake Superior area during the year were close to 4,500,000 tons, with around 3,500,000 being shipped from the large taconite plant of Reserve Mining Co. and the balance of the tonnage being shipped from the Humboldt and Republic operations of Cleveland-Cliffs on the Marquette Range and from the pilot plants of Erie Mining Co. and the Oliver Iron Mining Division on the Mesabi Range. With the Erie Mining Company taconite plant nearing completion at a rated capacity of 7,500,000 tons per year and the Cleveland-Cliffs developments on the Marquette nearing a rated capacity of 900,000 tons per year, there should be a total production capacity of taconite concentrates of close to 13,000,000 tons in operation sometime during 1957.

Although related primarily to the increase in shipments from Quebec-Labrador and Venezuela, the imports of iron ore in the United States in 1956 took another substantial surge and reached a figure which should exceed 31,000,000 tons. Of this tonnage, about 14,500,000 is from Canadian properties, close to 11,000,000 from Venezuela and with sizable tonnages from Peru, Sweden, Liberia, Chile and Brazil. This represents an increase of close to 7,000,000 tons over the actual 1955 imports of 23,400,000, which, in turn, was a new record at that time, representing a gradual increase since World War II from around 1,000,000 to 2,000,000 tons of imports per year.

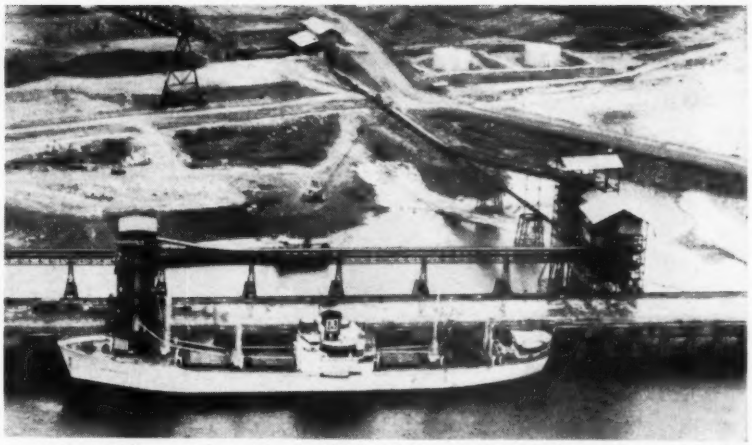
Also contributing to record-breaking iron ore productions in 1956 was the

tonnage produced in the Dominion of Canada, which reached an all-time high of close to 21,000,000 tons. This compares to productions of 14,500,000 in 1955 and approximately 6,500,000 tons in 1954. Although largely contributing to the increased Canadian production is the Quebec-Labrador area, nevertheless, almost every producing property of Canada showed increases from previous years. In addition to the 12,000,000 tons from Quebec-Labrador, there is about 3,300,000 tons from Steep Rock, about 2,500,000 from Wabana on the Island of Newfoundland, about 1,500,000 from the Michipicoten Range and smaller tonnages from the Marmora operation of Bethlehem Steel Company in Ontario and from the International Nickel Company's Sudbury operations, both of which are shipping very high-grade pellets. There is also about 900,000 tons from miscellaneous small sources, mainly produced in the western provinces.

Labor Difficulties

The final shipments from the United States areas of the Lake Superior district in 1956, including about 2,500,000 of all-rail, were approximately 76,000,000 tons. This will compare with 86,200,000 in 1955, and the decrease is basically attributed to the five-week strike which shut down most of the producing mines last summer and which continued longer for certain of the shipping companies that carry Lake Superior ore to the Lower Lake ports. Of significance is the fact that the average of 1955 and 1956 shipments from Lake Superior is approximately 64 percent of the iron ore consumed in the United States during these same two years. This compares to about 80 percent from Lake Superior for the ten years, 1943 to 1952, inclusive, when the average Lake Superior shipment was 77,600,000 and the United States consumption 96,600,000. Although the Lake Superior district has decreased in percentage of the total United States consumption, the average shipment of Lake Superior ore in these two years is greater than the ten-year average. Production of iron ore from other areas in the United States during 1956 was approximately 20,000,000 tons, as compared to 21,800,000 tons during the year 1955.

The consumption of iron ore in the United States was approximately 120,000,000 tons in 1956, as compared to an actual of 135,000,000 tons in 1955. Basically contributing to this decreased tonnage was the five-week steel strike during the middle of the year. In October of 1956, the latest figures indicate that the rate of iron ore consumption is again at the 135,000,000-ton level, as a total of 11,500,000 tons was consumed in that month. The consumption of iron ore is therefore at an all-time high, and the outlook is for a continued increase during the next few years as a result of presently increasing steel capacities and for an even greater increase in the long-range future as a projection of the gradual increase in steel production which has existed almost continually for the past 50 to 100 years.



Cerro Bolivar ore bound for the Fairless Works of U. S. Steel Corp. is transferred to ocean vessels at Puerto Ordaz, Venezuela

High Grade Ores in Demand

Any report on iron ore in 1956 would be incomplete without mentioning the change in perspective which has come about due to the taste of high-grade ores which the blast furnaces have for the first time had available in substantial quantities. Now that the iron makers have tried in their furnaces materials analyzing much higher in iron content than previous American shipments and large tonnages even in excess of 60 percent iron, the pressure for improving the grade of all shipping ores has been placed directly upon the iron ore producers. This means that many lower-grade ores which were absorbed in shipments during and after the war are no longer considered blast furnace grade. Of equal significance to the high iron content is a consciousness of better blast furnace operation by sizing and sintering or agglomerating raw materials to a much greater extent than has ever been in the picture before. The demand for better grade and structure, combined with the plentiful production capacities of all the iron-producing areas today, has intensified the competitive situation throughout the industry.

The desire for this high-quality iron ore, as well as the prospect for new demands in the future, has made the year a very active one in exploration and research. In the Lake Superior area, there is considerable activity on new sources of magnetic taconites

(Continued on page 130)

The high grade taconite product from new mills such as this one at Aurora, Minn., makes very desirable blast furnace feed

Placer mining monazite deposits in Aiken, S. C.

The Special Metals And Rare Earths

The immense undeveloped wealth of rare metal resources in this country and in the seas that wash its shores represent the promise of the future in the metals industry

By EUGENE B. HOTCHKISS
Vice-President
Vitro Corporation of America

WE quite customarily speak of the rare metals as though they belonged together by virtue of similar characteristics or properties. Even an inference of uniformity is hardly excusable in this age of scientific exactness, for individually the rare metals have very little in common. They aren't even all "rare." They differ widely in the prevalence in which they occur in nature. Some, common in other parts of the world, are promoted to the rare category in our country, mainly because of their strategic importance. Their value per pound ranges from cheap to very expensive; some rare metals are produced on a large scale, others by the gram. To further compound the confusion of nomenclature, we include in this group the metalloids, which exhibit properties somewhere between those of a true metal and a non-metal; the rare earths, which are neither truly rare nor are they earths; those new man-made elements that are produced by nuclear reaction; and the trans-uranics.

Perhaps some justification for this blanket classification may be found in their very diversity; perhaps more in our attitude toward them that sees unmeasured potentialities in their future. A kinship of fascinating dissimilarity bonds these unusual metals together. In common, they stimulate our technical curiosity in the search for newer and better materials. Collectively, they represent the promise of the future in the metals industry.

Therefore, let us borrow a term of scientific distinction used to designate other congeries of diverse talents and call this group hereafter the College of Rare Metals, nominating for membership those found in the accompanying table.

Diverse and Unusual Properties

A brief examination of some of these so-called rare metals will illustrate their diversity.

In prevalence, silicon, second only to oxygen as the most abundant element, makes up some 28 percent of the earth's crust. But pure silicon is produced at the rate of only a few thousand pounds per year. The rare metal tungsten is about as abundant as copper. There is almost twice as much zirconium in the earth's crust as zinc, and one is amazed to find rubidium, 16th in order of prevalence, al-

most as abundant as chlorine, but with a total annual production of only about 100 lb.

On the lower end of the prevalence scale, thallium occurs in the lithosphere to the extent of about 30 grams per ton, and although it is more abundant than arsenic, antimony, or mercury, its wide distribution does not represent its availability. Rhenium, occurring in the earth's crust to the extent of only 0.001 gram per ton, is indeed rare, while the manmade metals like promethium, produced only by nuclear reaction, do not occur in nature at all.

In physical properties there are also some striking differences. Thallium is so soft it can be easily scratched with the fingernail. Gallium will literally melt in your mouth since it goes into its liquid phase at some 13° F below normal body temperature. At the other end of this scale stands osmium, the hardest of all metals, and tungsten which has the highest melting point, 6152° F.

COLLEGE OF RARE METALS*

Beryllium	Scandium
Bismuth	Selenium
Boron	Silicon
Cadmium	Tantalum
Cesium	Tellurium
	Thallium
The Alkali Earth Metals:	Thorium
Calcium	Tungsten
Barium	Vanadium
Strontium	Yttrium
Cobalt	Zirconium
Columbium	
Gallium	The 15 Rare Earth Metals.
Germanium	
Hafnium	The Manmade Metals:
Indium	Francium
Lithium	Promethium
Manganese	Astatine
Molybdenum	Technetium
Nickel	
	The Trans-Uranics:
The Platinum Group:	Americium
Iridium	Berkelium
Osmium	Californium
Palladium	Curium
Platinum	Neptunium
Rhodium	Plutonium
Ruthenium	Einsteinium
Rhenium	Fermium
Rubidium	Mendelevium

* It should be noted that this selection of some 65 of the 101 presently identified elements in the period table has not been passed upon or approved by any committee and that the selection is admittedly arbitrary.

The electrical properties of the rare metals are equally interesting. Boron, a feeble conductor at room temperature, becomes quite conducive at high temperatures. Vitreous selenium is a dielectric, while in one of its other allotropic forms it is a good conductor. Germanium owes its important use in transistors to the fact that it is a semi-conductor, and recent reports indicate lanthanium, one of the rare earths, is a super-conductor.

Variations in age are notable too. The mineral beryl was mined as a gem in Egypt 5000 years ago, but the metal beryllium, the lightest stable metal with a high melting point, was not known until late in the nineteenth century. Osmium, the heaviest of all metals, was found in the native state with others of the platinum group in precious metal brought back by the Conquistadores in the mid-1500s. Mendelevium, first produced a little over a year ago, certainly qualifies as the youngest rare metal, but its half life is so short that it will undoubtedly pose some unique membership problems in the College of Rare Metals.

In the interests of brevity no attempt will be made to catalogue the infinite variety of their chemical properties or their nuclear behavior.

These, then, are our rare metals. Only a few have been mentioned and the examples were selected primarily to illustrate diverse and unusual properties. Old or new, rare in occurrence or rare in use, hard, soft, reactive, or passive, they represent a most unusual collection of substances, richly deserving the distinction and honor of membership in the College of Rare Metals.

Can a Pattern Be Detected?

But fascinating as they are as rare metals, the future promise of those we can coax out of their obscurity into the profitable service of mankind commands a much more practical interest. It is as common, rather than rare, metals that they will spark the new industries of tomorrow. Can we determine the factors that are significant in their transition from rarity to availability? Can a pattern be detected in the transition of recently available but once rare metals such as aluminum, magnesium, or titanium that might help us to predict when and how others might join these illustrious alumni of the College of Rare Metals?

We can list several factors that were significant in the change of these three light metals from relative obscurity to economic importance:

(1) The recognized need for new, strong, lightweight structural metals;

(2) The abundance of each of these three in the earth's crust that stimulated a desire to put them to use;

(3) The assurance that a large and profitable market awaited the successful solution of the problems of process technology and fabrication.

How did these factors operate in the case of aluminum? About 35 years of research and process development followed the first laboratory production of the pure metal before Hall achieved his technological breakthrough that demonstrated how aluminum could be produced economically. We do not know the cost of this effort, but it is of interest that the research, application engineering, and market development, which followed each other in orderly fashion, were solely the efforts of private risk-taking in an atmosphere of free enterprise and peace.

EUGENE B. HOTCHKISS, a graduate of Michigan College of Mining and Technology, is vice-president of Vitro Corporation of America in charge of new business and raw materials. Formerly vice-president of New Enterprises, Inc., Boston, Mass., he is treasurer of Vitro Engineering, Inc., and a director of Kaman Aircraft Corp.

During the last war Hotchkiss was with the Office of Scientific Research and Development and became deputy chief of its London Mission.

As vice-president of Vitro, Hotchkiss is working with a diversified industrial organization which, among other things, took some of the original and important steps in the production of atomic energy, including the design and engineering of the original gaseous diffusion plants at Oak Ridge and production of plutonium facilities.

The story of magnesium differs from that of aluminum. The magnesium industry was a German monopoly imported to this country under the threat of World War I. Judging by U. S. production, which languished around a few hundred tons per year until there was a sharp rise in the early thirties, the problems of process technology were not solved until then. But in magnesium, the factor of need was heavily underscored by war-time strategic requirements, which, heavily backed by federal subsidy, created a tremendous demand before industry was technologically ready to supply it.

The process breakthrough had hardly occurred before the defense program of World War II expanded magnesium production manyfold, from 5300 tons from one plant in 1939 to over 180,000 tons from 15 plants four years later. At the end of the war one plant was again the sole producer. The total federal spending on magnesium was probably substantial.

The titanium industry got off to an even faster start than magnesium in another period of emergency, and under the direct initiative of the government. A much more imposing array of government spending programs appeared. Again we see the factor of strategic need for a little known metal causing a crash procurement program well in advance of the process breakthrough that normally signals the start of a new extractive industry. It

is estimated that the total cost of this program to the government, including government-financed research in processing and production, plant loans, the maintenance of production aids, together with G.S.A. stockpile purchases, totaled somewhere around 175 million dollars.

As far as a pattern is concerned, we can note that in each of these examples the difficulty of extracting the metal from its ore or source and fabricating it into useful forms disputed the promise of its prevalence in nature. And in each case, a costly, arduous, and long research program had to be successfully completed before the metal became an article of commerce.

By no means should we depreciate the widespread industrially-sponsored activity that took place concurrently, nor can we deny that our economy will

Cost of the program, exclusive of uranium weapons development and production, has been estimated to be in the neighborhood of 14 billion dollars

be enriched by the availability of this new light metal much sooner than would have been the case without vast government support. But in the case of magnesium and titanium we might question whether the development of our newer metal industries must of necessity occur in an atmosphere of national urgency and be dedicated first to the destructive arts of war.

Uranium Program Costs $14 Billion

We can look at some other examples. Without doubt the history of uranium illustrates the ultimate effect of the forces of extreme national urgency, brought on by world war and continued by an unsettled peace. Never before has our national security been so thoroughly tied to a single metal, which a short decade and a half ago was known as a little wanted by-product of radium refining. The immense problems of scarcity, lack of basic knowledge of its properties, and the gravest question of all—whether its predicted behavior could be safely demonstrated and controlled — were far beyond the capabilities of private enterprise to handle.

Under a time schedule that appeared impossible and the necessity of the most stringent security controls, there was no other way of creating this industry except as a ward of the government. The cost, exclusive of weapons development and production, has been estimated to be in the neighborhood of 14 billion dollars—the cost of 80 titanium programs.

We may hope that this example does not indicate a pattern to be followed in the case of other rare metals, but it brings home forcibly the vital necessity, as well as the immense cost, of the research, process engineering and solving of many complex metallurgical, chemical, and fabrication problems that were involved in the development of this new metal industry.

Other Examples Cited

Molybdenum is one of the relatively few new rare metals, now established as an industry, in which private initiative in research outpaces federal subsidy. The Bureau of Mines says: "At least part of the spectacular growth of the molybdenum industry can be attributed to research sponsored by the producing firms."

We can cite two more examples: Beryllium, where private initiative has been particularly active; and zirconium, where federal leadership is more apparent. In both cases, recent government procurement contracts for many times the present productive capacity of the industries involved have caused a flurry of competitive bidding and crash development of new processes.

We cannot object to the aspects of competition in technological development or its effect on prices, and the plans of the zirconium and quite possibly beryllium producers to turn out quantities in excess of government requirements will certainly advance the industrial importance of these metals. But when a new business, or one about to be vastly expanded, has only one customer, whose requirements are dictated primarily by military considerations, we may ask ourselves again—must the peace-time uses of our new rare metals always be a by-product of their strategic war-time need?

In the present state of international nervousness, it is hard to plan effectively for the less critical times we hope for in the future. We must never forget that industrial strength is our nation's best guarantee of peace and the strongest deterrent to potential aggressors. We should of course continue stockpiling those scarce materials on which our productive capacity depends and intensify the search in our own country for the minerals we might not be able to obtain from abroad in time of war. In fact, further progress in all of the technologies that might make us invincible in war is vital.

Research and Development

But neither should we forget that many of these same objectives can also be accomplished by research and development dedicated to the objectives of making available more and better goods for a higher standard of peace-time living.

It is here that the rare metals field is particularly and adversely affected. In many cases, our knowledge of their true properties is very limited, and we have had ample demonstration of their resistiveness to extraction by classical processes. In few instances, indeed, is there assurance that a profitable market awaits. To further complicate the situation, the determination of the properties of rare metals depends in general on a much higher state of purity than is the case for the more common ones, and their preparation in anything like a pure form will often depend on the development of special techniques.

This can only be accomplished by long, arduous, and costly research; but it is particularly difficult for the small and medium-sized business enterprises interested in this field to raise the money necessary to carry on such programs. Banks will not loan the money, the business seldom generates sufficient funds, and risk capital for research is very difficult to obtain. Yet the contribution these small and medium-sized businesses can make to our national economy depends as much on this financial backing as it does on the imagination and perseverance of those leading the research.

Our experience at Vitro has taught us there is no short cut to a bonanza in this field. At what is now our Rare Metals Division, we produced the first gram of radium refined in this country nearly 25 years ago. We have been active since 1942 in the emergency transition of uranium from rarity to relative abundance. More recently we have extended our interest to other rare metals and the rare earths.

The reasons why we are increasingly active in this field, despite the hazards, the difficulties, and the problems I have cited—that particularly affect a medium-sized company like Vitro—are these. We have seen in the past 20 years a phenomenal increase in the knowledge of the physical sciences and their industrial application. We expect this trend to accelerate in the future. The opportunity of sharing in the direction of this increasing force of technology, in attacking the immense undeveloped wealth of rare metal resources in our land, and in the seas that wash our shores—this opportunity is to us a fascinating challenge.

Advent of the 60-yd type shovels introduced a new stripping era

Strip Mining

Bigger and faster seem to be the passwords to more efficient production as cover gets deeper

By THERON G. GEROW
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One of the pioneer strip miners in this country, THERON G. GEROW joined Truax-Traer Coal Co. as an engineer in the North Dakota Division in 1927. He was instrumental in the development of large scale open pit mining of lignite in North Dakota and western Canada and later developed two large strip mines for that company in Illinois. He was elected a director of Truax-Traer in 1942 and in 1947 advanced to the position of executive vice-president. He resigned in 1951 to become president of the West Virginia Coal & Coke Corp. Shortly afterwards he guided the formation of Paradise Collieries, Inc., and became a director and president of it as well. In 1954 he resigned to enter the consulting field.

ANOTHER milestone was passed during 1956 in the advance of strip mining practice. Many new machines and methods completed their trial runs and have become accepted by the industry.

This stage in the advance of strip mining has been developing over the past several years and was brought about largely through the heavily increasing demand for a low cost fuel for power generation and industrial use, coupled with large annual contractual tonnages and long term reserve requirements.

Although strip mining equipment and methods have been steadily improved since the early days of steam, stripping machinery has been developed through definite stages of machine design. The eight-cu yd shovel, improved by bucket design to ten yards, was standard for some time. Then the 12-yard class shovels, increased again by bucket design or the use of counter-weights to 18-23 cu yd, remained standard for several more years. Closely following came the 33 and 40-cu yd units designed for greater capacity and range, again improved through bucket design to the limits of their structural and mechanical abilities to carry buckets having up to 50-cu yd capacity.

The new 60 cu yd shovel design, which together with the 30 to 35-cu yd heavy duty and long range dragline, has opened a new era for stripping. Many auxiliary units with higher capacity and capable of heavier duty to keep pace with the primary stripping units have been developed and accepted as standard by the industry.

A new and progressive attitude seems to prevail in the industry. At several previous stages, both operators and manufacturers seemed to settle back and say "this is it." Today's attitude seems to be "what's the problem?" and "let's see how to accomplish it best."

All this aids the smaller operator as well as the large. He is making use of higher capacity and longer range equipment made economically available to him by the progress of the larger companies. He is moving much heavier cover, making better costs and is generally better able to do a satisfactory job in meeting his local demands.

Stripping

The first of the 60-cu yd class stripping shovels has proved itself at the Hanna operations in eastern Ohio.

This unit required a completely new and heavier design from the ground up in order to carry the 60-yd bucket and provide increased range. Hanna's forecast, made at the American Mining Congress meeting last May in Cincinnati, of 2,000,000 cu yd a month has been realized with excellent operating and maintenance records. The coal company's management seems well pleased with performance and operating results.

The second machine of this class is (at the time of this writing) still under erection at the River Queen Mine of Peabody Coal Co. in west Kentucky. This will be an interesting shovel, designed for two seam stripping to be operated from the lower bench. It will be rangy, with a high shipper shaft location for upper bench stripping. Both coal seams will be stripped simultaneously.

Other machines of this class are either presently on order or in the stage of very serious consideration. Present day demands for large annual tonnages requiring large stripping reserves are forcing the operators to increased depths of stripping and heavier ratios. Even the 60-yd shovel with a 73 to 75-ft depth limit on straight cast and in a straight-away pit does not fill the bill to depths now being considered economical to operate.

To meet the demand for stripping to depths of 85 ft and deeper, both the long range dragline and the wheel excavator have passed the experimental stage and can be considered established and standard.

Thirty to 35-cu yd long range draglines are now standard, bringing with them increased power, longer booms and faster cycles. A number of these machines are in successful operation and it is understood that higher capacity units are under consideration for the near future.

The wheel excavator has proved its worth where overburdens permit its operation. The United Electric Coal Companies, who originally developed the machine for use in this country, have built three such machines which are in successful operation. The Truax-Traer Coal Co. has a factory built unit at its Fiatt, Ill., mine which gave splendid operating results during 1956. It has a range to about 80 to 85 ft.

Although a rather specialized long range and high capacity auxiliary unit and not presently a production line item of standard design, the "Wheel" has definitely taken its place as an auxiliary stripping unit that will find many applications. It is not, however, a prime mover that can work independently as can the shovel or dragline.

Multiple Seam Stripping

While multiple seam stripping is not by any means new to the industry, 1956 seems to have focused considerable attention on two seam stripping and special equipment for handling it. The problem has previously been met successfully with several combinations of equipment, as a rule the most common was the use of draglines because of their operating range and flexibility.

Probably the first single unit to strip both benches at the same time was the specially designed 32-yd two seam stripping shovel built for the Will Scarlet Mine of Stonefort Corp. in southern Illinois. This machine has a 133-ft boom and a high positioned shipper shaft location for upper bench stripping with the machine operating from the lower bench. Now comes a similarly designed machine of 60-yd capacity for the River Queen Mine of Peabody Coal Co. in west Kentucky.

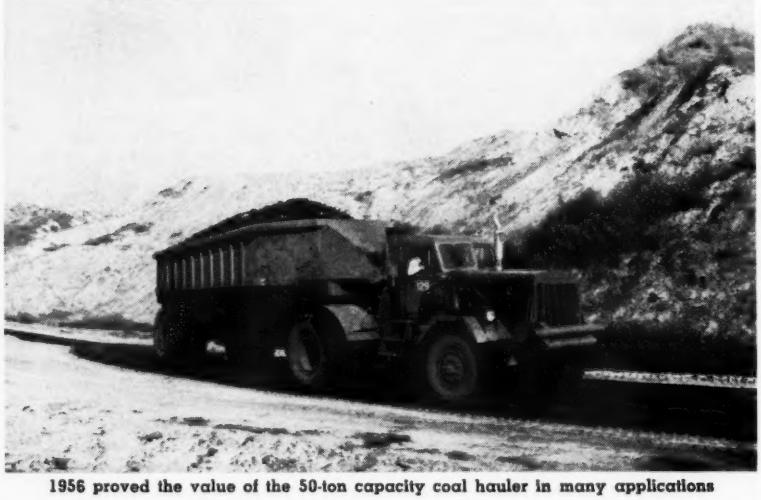
Ayrshire's new Gibraltar Mine in west Kentucky meets the problem by using a 42-yd 135-ft boom stripping shovel operating on the upper bench with a specially designed six-yd high lift shovel operating on the lower bench taking the interval between the two seams. Unique at this operation is the 10-yd high lift loading shovel loading the lower seam coal into trucks on the upper seam. Both high lift shovels (stripping and coal loading) are identical except as to bucket size and function.

Also worthy of note at this mine is the special four-armed rock drill mounted on a 42T drill chassis built by the company for drilling and shooting the rock interval between the two seams.

In the same general area Paradise Collieries has been using successfully for some time a 20-yd standard stripper with a dragline auxiliary for two seam stripping; and the Colonial Mine (both Pittsburg and Midway Coal Co. operations) has been using the more or less conventional dragline system for the dual seam operation.

At the new Lynnville Mine of Peabody Coal Co. in southern Indiana, another high capacity strip mine, a 30-yd long range dragline is used as a prime mover for the upper seam overburden with a six-yd auxiliary dragline removing the interval between the two seams.

Apart from dual seam operation but of considerable interest has been the invasion of the West Virginia contour stripping field, formerly a small machine application, by Truax-Traer Coal Co. with a 19-yd standard stripping shovel working high up on the mountain. Its 1956 results at their Marfork Mine on Dorothy Coal have proved most satisfactory.



1956 proved the value of the 50-ton capacity coal hauler in many applications

Drilling and Blasting

Although nothing of extreme importance developed in drilling and blasting practices during the 1956 year itself it can now be said that for vertical work, even when using smaller rigs, development over the last few years has standardized the use of the air-blast rotary drill, capable of high penetrating speeds—up to 900 and 1000 ft per shift with holes ranging from 6 to 10½ in. in diameter. Horizontal drilling in rock, we are told, is due for new developments in 1957.

The use of the new ammonium nitrate blasting compounds now almost universally obtainable with plastic bag containers has become, during the year 1956, widely accepted as a means for achieving highly satisfactory overburden preparation. This type of explosive has apparently passed its experimental stages quite successfully and is in widespread use.

Loading and Haulage

The loading shovel has steadily improved over the years with no particularly startling advance at any one time. Large capacity coal loading dippers up to 10-yd capacity are now the rule.

Much the same can be said of coal hauling trucks, except that this past year has proved beyond doubt that in many applications the 50-ton unit is highly practical and provides cheaper haulage. It has given a splendid account of itself in proven operations both as to cost and maintenance. The successful development of the 400-hp diesel engine has been a large factor in the success and speed of operation of the large units. If it has not already done so, the 50-ton or larger unit will shortly obsolete haulage units of under 40-ton capacity except where extraordinary conditions prevail.

Preparation

The trend at most of the larger strip mines requiring new preparation facilities or at entirely new operations is to simplify the cleaning plant and cater to industrial and utility sizing and cleaning only. River loading facilities are proving increasingly important and a low operating cost is a "must."

Stockpiling of raw coal at the cleaning plant is becoming increasingly popular to act as a surge supply as well as to provide blending facilities. The stockpile provides complete independence of the preparation plant and mining operations.

At the Gibraltar Mine of Ayrshire Collieries, management has gone one step further and provided a stockpile of the washed product to provide flexibility in loading out to their river barge loading facilities.

Reclamation

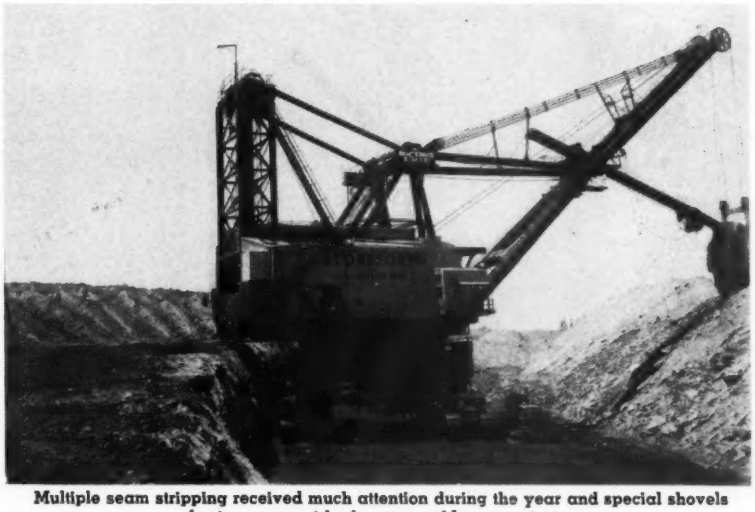
Reclamation has become a very necessary cost factor to be considered by all strip mine operators. Fortunately, most of the larger operators include this in their cost figures and are doing something about it. Many are doing a splendid job.

Attention is being focused on the necessary economical equipment to accomplish the work. During the year new large tractor-bulldozer equipment has proved its worth, with some of the rougher work being done by walking draglines. Now that reclamation and leveling is becoming routine in the industry, certainly it is to be expected that even more suitable equipment will develop to keep pace with the rapid developments in stripping.

Highwall Mining

The use of the coal auger has been more generally accepted as an auxiliary to strip mining, particularly in contour stripping where stripping limits are reached much more quickly than in the more gently rolling terrain of the Middle West. The large diameter high capacity and heavily powered units have been turning in splendid results, both as to tonnage and cost.

It appears that the broad subject of "Highwall Mining," including the use of standard underground equipment as well as augers, has not received the attention, study or engineering consideration that it warrants. Coal strippers are rapidly being forced to higher overburdens, heavier stripping ratios and the handling of more rock and difficult overburden to obtain the necessary reserves to meet the demand for cheap coal. To meet these conditions both the capital cost of equipment and the operating costs go up rapidly. Highwall mining in many cases would prove an economical solution.



Multiple seam stripping received much attention during the year and special shovels for two seam stripping saw wider acceptance

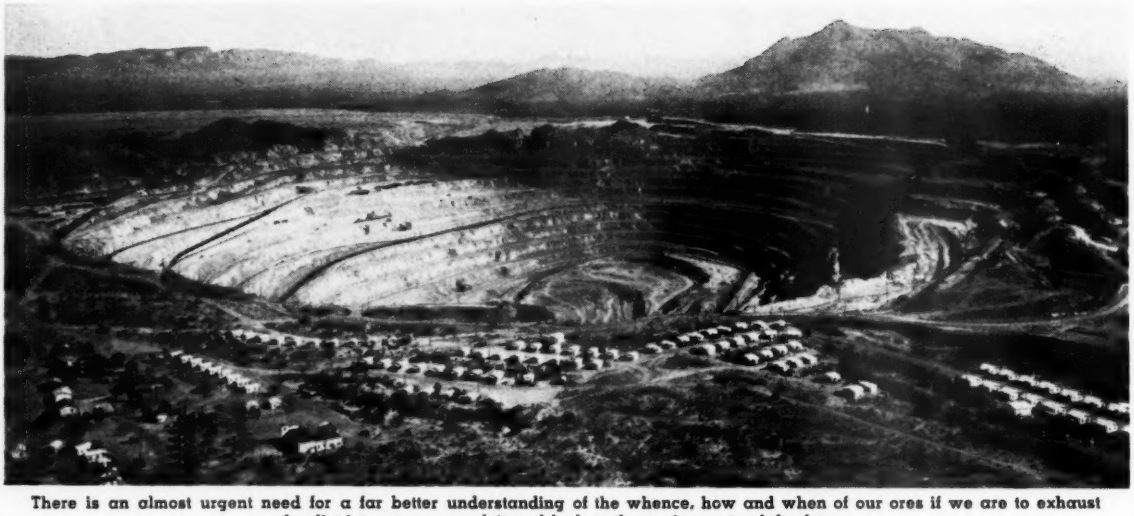
Engineering and Planning

Present day strip mining requires considerably more engineering and advance planning than in the past. Many of our present strip mines have grown up with additions in equipment and plant made from time to time as new and better equipment became available or as additional capacity demanded.

Most of the mines that have opened in the past year or two, particularly those opening or in the construction stages during 1956, have been carefully planned and engineered to meet specific requirements. With the high cost of equipment and tougher operating conditions that must be met today, great care must be exercised in the early planning and selection of equipment to be assured of a fair return on the heavy investments required.

Actually "return on investment" may supplant the old coal mine "yardstick" of "profit per ton" just as the "cost per million Btu's" has supplanted the "cost per ton" in the mind of the large utility buyer. Certainly it is most important to the coal operator and his financial position when considering a new venture or substantially improving an old property.

The coal auger has become an important tool in the hands of contour strip miners



There is an almost urgent need for a far better understanding of the whence, how and when of our ores if we are to exhaust the districts we now exploit and look to the rquirements of the future

Mining Geology in 1956

An eminent geologist emphasizes the need for better organized research to gain more accurate knowledge of the physical-chemical processes responsible for the creation of ores

By RICHARD N. HUNT

Vice-President and Chief Geologist
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ARTICLES describing uranium occurrences and prospecting techniques continue to outnumber those concerning other metals. Initially stimulated by AEC and certain early successes in exploration, 100,000 prospectors during the past 15 years have revealed the abundance of uranium in minable deposits in this country and Canada. Activity continues but at a less frantic pace. The gamble now is, will peacetime uses absorb production as it mounts above probably already filled military needs? If they do and uranium production becomes a major industry in the sixties, all of the uranium of this country and Canada still will not have been found. Occurrences will have coagulated into districts—the ore-habits of which will guide exploration to non-outcropping deposits. And the uranium mining industry will probably then enjoy exploration opportunities comparable to those in other metals.

A mine of information for the uranium geologist is "Contributions to the Geology of Uranium and Thorium by the United States Geological Survey and Atomic Energy Commission for the United Nations International Conference on Peaceful Uses of Atomic Energy, Geneva, Switzerland, 1955," Professional Paper 300.

In the Fiftieth Anniversary Volume of *Economic Geology*, McKelvey, Everhart and Ganels sketch uranium occurrences and venture opinion as to the origin of the "primary" uranium ores of the world. With possible exceptions and hesitation they lean to the hydrothermal side of the current controversy.

Gruner, however, in *Economic Geology* (September and October) consistently continues his emphasis upon secondary genetic agencies, whatever the original source of uranium. Uranium certainly is most mobile. But groupings of deposits into districts in which intrusives and usual hydrothermal associations are present strengthen the pro-hydrothermal bias of most Western geologists.

In *Mining Engineering*, January, King describes "Uranium Deposits in the Black Hills" as being controlled by minor structural factors such as "flats" which are assumed to divert or inhibit circulation and somehow cause deposition of the ores.

RICHARD N. HUNT, a graduate of the University of Wisconsin, has a broad background in geological work. In addition to working for many years as a consulting geologist for mining companies throughout the Western States and in Mexico, he has served the U. S. Smelting Refining and Mining Co. since 1938 as chief geologist and as vice-president and director since 1952.

In *Mining Engineering*, June, Joubin and James briefly describe sheets of bedded ore in the Blind River area of Ontario measuring thousands of feet on dip and strike, likening them to the reefs of Witwatersrand but mentioning intrusives and evidences of hydrothermal fluids. In the same issue Lang and Steacy briefly recount the uranium story in Canada from Great Bear Lake through Beaverlodge and Blind River to the pegmatite deposits near Bancroft, Ontario, noting that in Canada thus far there is about one assured producer for every thousand known uranium occurrences.

Many descriptive papers on uranium occurrences in western states appeared in the March issue of *The Mines Magazine*, published by the Colorado School of Mines Alumni, including a description by Gabelman, Young and Ealy of what is probably the uranium district with greatest tonnage potential of any known area in the United States, Ambrosia Lake, McKinley County, N. M.

From coal and phosphate beds, sandstone and limestone, to quartz veins, granite contacts and pegmatites the occurrence of uranium bids fair to be more varied and widespread than that of gold, and in abundance in the earth's crust to outrank gold, silver, mercury, antimony and tungsten.

Non-Ferrous Geologic Papers

Numerous papers descriptive of non-ferrous metal districts and mines appeared in 1956.

A U.S.G.S. Professional Paper, "The Stratographic Section in the Vicinity of Eureka, Nev.," by Nolan, Merriam and William, is probably a precursor of a comprehensive study of a grand old Nevada mining district on which Tom Nolan, now the capable Director of the Survey, and others have been laboring for many years. There also appeared another professional paper by Hewitt on the Goodsprings region to which he has devoted so many years, "The Geology and Mineral Resources of the Ivanpah Quadrangle of California and Nevada."

Another professional paper, "Geology and Ore Deposits of the Bagdad Area, Yavapai County, Ariz.," by Anderson, Scholz and Stovell, is an excellently presented study of that struggling and interesting district.

A well illustrated U.S.G.S. bulletin (1027-H) describes the well known Christmas Copper mine of Arizona. In providing geologic maps of mine levels and vertical mine sections, it follows an early U.S.G.S. tradition established by Becker and S. F. Emmons. It is unfortunate that uncertainties as to vertical boundaries, attributable in part to the apex and extralateral right provisions of Federal mining law, and other considerations sometimes make it difficult for the Survey to obtain complete underground information in active districts.

In western states the geologist's need in geophysics is methods effective in a three dimensional geometry deep within debris-covered or outcropping bedrock formations

Other contributions to economic geology by the Survey appeared in the same bulletin. Parts E, F, M, N, P, O, and K describe the silver veins of the Sugarloaf and St. Kevin district, Colorado; the copper deposits in the Helvetia district, Arizona; the extension of Coeur d'Alene district geology into Western Mineral County, Mont.; lead and zinc deposits of the Murray area, Shoshone County, Idaho; thorium in the Powderhorn district, Colorado; and drilling by the Survey for lead-zinc ores in Dubuque County, Iowa. The propriety of any government agency actively undertaking prospecting is of course open to question. The Survey's success years ago in initiating drilling for potash in New Mexico, and, in recent years, AEC's success in uranium may be special cases justified up to some point as stimulating exploration for a new national resource not known or confidently believed to exist in commercial quantity.

Foreign Mines and Districts

Extension of the Survey's investigations into Latin America has resulted in two professional papers on the Zimapan silver-lead-zinc district, Hidalgo, and the Boleo Copper district, Baja, California, and in two bulletins describing the general geology and phosphate deposits of the old copper district of Concepcion del Oro, Zacatecas, Mexico, and the minor lead-zinc-silver deposits of the Atacocha district, Departmento de Pasco, Peru.

In *Economic Geology* appeared informative descriptions of other Latin American mines and districts:

The Frisco Mine, Chih., Mexico (Jan-Feb. issue) by G. S. Koch, Jr.

The Quirurilca district, Peru (Jan-Feb. issue) by R. W. Lewis, Jr.

The Cantera Mine, Mexico (Jan-Feb. issue) by J. C. Stone.

In a bulletin of the Geological Society of America, (Vol. 67, No. 4), Hague, Baum, Meriman and Pickering, geologists for the New Jersey Zinc Co., provide the first published description of the geologic setting of that company's Franklin and Sterling mines, the oldest and perhaps the most productive zinc operation in North America.

The numerous, but comparatively small, lead-zinc-bearing deposits of Tunisia are described by Sainfeld in *Economic Geology* (March-April) as widely scattered hydrothermal ("telethermal") fissure-controlled bodies, largely in carbonate rocks, and as being loosely associated with Triassic volcanic but no intrusive rocks.

The academic duties of many students of ore deposits render them rather too dependent on the writings of others and perhaps a modicum of laboratory work, all more accessible to them than facts in the field. It is fortunate that occasionally a fieldworker ventures into print as has R. T. Walker, assisted by his son, W. J., in "The Origin and Genesis of Ore Deposits." A prefactory study "The Origin and History of the Earth" was published in 1955. Clearly, often brilliantly, he integrates with much reading a lifetime of indefatigable field observation in mines and districts. In the quiet of retirement in lucid, rapid style, at times with some abandon and considerable assumption, but close-packing much original thought and information, he writes of those things to which he has devoted his life and means.

In the *Mining Journal* (June) we learn that our Canadian friends have moved into Ireland, where a bill, pending or passed, promises new operations four years freedom from income taxes. The Mogul Mining Corp. has taken a 21-year lease in the old sulfide district of Avoca, County Wicklow, and is looking at the copper district of Bonmahan. The Mining Corporation of Ireland (part Canadian), with $5,000,000 in capital, plans exploration in old zinc-copper areas of Castleblaney, County Monaghan, and of Beaupare, County Meath, and is investigating the eighteenth century copper mines of West Cork. An American geologist visiting British geological and mineralogical museums is impressed by the numerous localities in Britain from which ore specimens in these splendid collections have come and wonders whether any of them, mostly insignificant mines by modern standards, would yield to exploration.

An August issue of *The Mining Journal* describes "Operation Overthrust—A New Conception in Minerals Exploration," probably the largest aerophoto mining exploration project yet undertaken: 357,000 square miles of the Canadian wilderness

north of the Great Lakes, with 400,000 square miles of extensions planned. Several mining companies have joined in a two- to three-year project combining electromagnetic and magnetometer data, plain and color photography and the skills of geologists, soils engineers, hydrologists and foresters in the preparation of one-mile to one-in. mosaics. Geologic data from all known sources will be added. At a cost of a few millions, exploration of a vast region may be set ahead a decade or two.

Geophysics

Geophysics, though still of far greater use to the oil geologist than to the mining geologist, nevertheless slowly adds tools to the latter's kit. Authoritative and outstanding is Slichter's review, "Geophysics Applied to Prospecting for Ores," in the Fiftieth Anniversary Volume of *Economic Geology*. As a matter of deriving a maximum of information from an amount of drilling and of minimizing cost, Slichter proposes greater use of mathematics in the form of the probability theory applied in situations in which initially a random distribution of orebodies may be assumed, an approach in which he as mathematician is much interested. In a second section Slichter describes eight current exploration techniques with field examples, figures, maps and profiles. If we may venture an observation, it would be: that none of the eight methods is of universal usefulness; that at times two or more methods increase the worth of each; that aeromagnetic and ground magnetic methods definitely are positive tools in iron ore exploration, and sometimes in that for base metals; and that they and electromagnetic techniques are the most generally useful, especially in a first passover large virgin areas such as the north country. Structural lines may be delineated if not significant local anomalies. Examples cited of success in such regional work are extension of the Vermillion iron range 200 miles to the southwest beneath glacial drift; the Whistle mine at Sudbury of International Nickel; American Metal's Little River property in New Brunswick; and Hanna's Burwash Lake (Ontario) discovery. Of special note is Slichter's comment upon equipment recently devised by Varian Associates and Hycon Aerial Surveys: A "nuclear resonance magnetometer" for airborne operations which introduces "a new absolute method for measuring magnetic field strength dependent directly upon properties of the atom rather than upon properties of permanent magnets or the geometry of electric circuits."

Also of interest is Allen's paper in *Mining Engineering* (March) describing as effective the use during the past six years of gravity surveys underground at Bisbee in reducing crosscutting and diamond drilling. Fairly uniform densities and adequate spreads of workings appear to be requisite.

Murray and Hoagland in a G.S.A. bulletin (June) describe the successful use of direct current applied potentials in "Three Dimensional Applied Potential Studies at Austinville, Va.," developing elongate disseminated sphalerite pyrite galena bodies in dolomite. The work was done concurrently with and aided in guiding surface drilling. Of interest was the anisotropic character of resistivities, the greatest elongation of the equipotential contours being with the bedding plane axes.

Seigel in THE MINING CONGRESS JOURNAL (March), perhaps with some bias forgivable in a geophysicist, describes the use of airborne electromagnetic equipment, followed by ground-electromagnetic and gravimetric or geochemical work "in locating" 60,000,000 tons of lead-zinc ore in three years time in New Brunswick.

Most successes to date of geophysics applied to prospecting for sulfide ores have been in Canada where the problem has been essentially that of detecting sulfide bodies in sub-outcrop on bedrock beneath mantles of glacial and vegetable debris. In the Pima copper mine, a geophysical discovery of recent years, the sub-outcrop lays beneath 200 ft of valley fill but on line of projection, a matter of a mile, of fissures known in properties now worked by the Banner Mining Co. However, this is no deprecation of a smart exploration job by the United Geophysical Co. of Pasadena.

In western states the geologist's need in geophysics is methods effective in a three dimensional geometry deep within debris-covered or outcropping bedrock formations.

Plight of Non-Ferrous Metals

At the present time the prospecting public is less interested in the search for ores of the common metals than for uranium—and it might be added—than for oil and gas. In these favored industries incentive for profit lures literally billions of dollars of private capital into exploration activities in this country and Canada. The recent flair in the price of copper, probably now declining, does not obscure the anomaly in our domestic non-ferrous metal industry of unprecedented peace-time demand unreflected in metal prices, except that of copper, and of declining domestic mine production of lead and zinc during the past several years. Higher metal prices or lower production costs would stimulate domestic production. But neither can be hoped for soon in view of world over-production stimulated by nearly two decades of rising demand or in the face of our own annually increased labor costs. Unlike steel non-ferrous metals sell on a world market and cannot pass on the bill for wage increases to the American public. And gold sells under price ceilings fixed decades ago.

But the plight of our domestic non-ferrous metal industry is only in part attributable to an unfavorable economic climate. The pickings are not what they used to be. Reserves decline each year and new sources on which we must depend in the future are sought more abroad than at home. Geologists cannot attribute declining interest and reserves entirely to unfavorable economics. Perhaps it behooves mining geologists to sharpen their picks.

Possibly awareness of our situation may be responsible for the emphasis that recent geological papers have placed upon matters of research. Of approximately 200 papers and publications considered here, dealing with the geology of ores and mineralized areas or with prospecting for ores, about one quarter of them describe research in geology, geophysics and exploration techniques, much of it of fundamental character. Many papers reveal that mining geologists are increasingly aware that the advance in our understanding of the genesis of ore deposits the past several decades has not been notable.

Whence, How and When?

Over 40 years ago Lindgren published his classification of primary oxide and sulfide ores based on assumed effects of temperature and pressure occasioned by depth upon their chemistry and mineralogy. Two generations of American geologists have been brought up on his classification. But as indicated by Noble and others in the Fiftieth Anniversary Volume of *Economic Geology*, it is arbitrary and it encounters inconsistencies in field facts. Brilliantly conceived and elaborated through the years, only very generally does it outline a theoretical conception of the genesis of primary oxide and sulfide ores. As Lindgren himself once remarked in Butte, "We know all about the geometry of these veins, but little about what happened in and along them." He did not have the analytical equipment of our present laboratories. He lacked exact chemical and mineralogical facts. He could not give the prospector the details of the whence, how, and when of them, such as he in his digging could apply in the specific case—which is the only case of interest to the prospector and mining company. The work in recent years of Sales and Meyer, closely integrating observation underground and in the laboratory, appears to have made at least a beginning in supplying the lack in Butte, and perhaps elsewhere, of which Lindgren spoke many years ago. Lindgren tended to assume, what increasingly in the field

appears to be the fact, that the primary ores of the common non-ferrous metals are akin and the product of one genetic process, complex and varied from district to district though it be. And it was axiomatic in Lindgren's thought as in that of Van Hise, Leith and others of his day, that insofar as he understands the genesis of an ore deposit, a geologist has his prospecting tools. The more penetrating tools he needs today can come only from more accurate knowledge of the physical-chemical processes responsible for the mineralogy of our ores, knowledge which can only come from a well organized and financed research such as we have had very little of in mining geology.

In the Fiftieth Anniversary Volume of *Economic Geology*, McKinstry with many illustrations describes the infinitely varied physical settings and forms of what geologists more or less agree are deposits somehow attributable to hydrous or gaseous thermal agencies. After postulating the necessity of (1) a source of the generating "fluids," (2) "channelways" for them, and (3) "space" for deposition of the ore minerals—he takes leave of the whence, how and when of the problem of sulfide ores to describe what the eye, pencil and scale of the mining geologist can so ably plot. Much may be deduced of the travelling habits of ore generating agencies by such reviews of the geometry of orebodies and of their host structures. In any district once these habits have been determined, usually at a mature state of the district's development, the mining geologist can extrapolate and like an architect lay out the floor plans of successive levels. As McKinstry states, "knowledge of the structure of ore deposits has increased remarkably during the present generation." Mining geologists have become good geological engineers. But they who are closest to the facts have learned little of the chemistry and physics responsible for the mineral assemblages and ores they map. And the problem of "how, whence, and when" remains much as it confronted geologists a half century ago.

Park in the same anniversary volume puzzles over the zonal distribution of metals and minerals so common in mining districts and sometimes on restricted scale within orebodies and veins. He reviews attempts to explain the dispersion of metals according to their relative solubilities, or their volatilities, their electrode potentials, or other atomic characteristics. After an excellent review of many examples and reference to 72 geologic papers by others, he sensibly concludes that it would be well to restrict "zoning" to use as a simple descriptive term and leave to the future generic explanations.

Schwartz in his usual, clear practical approach indicates in "Hydrothermal Alteration as a Guide to Ore" that the spreading aprons and halos of hydrothermal effects within ores, especially copper ores, so frequently occur are more useful as "guides" when component sericitic, chloritic, carbonate, jasperoid, feldspathic and clay minerals are isolated and presumably mapped, the significant minerals varying with the district.

Again in "Argillic Alteration and Ore Deposits" *(Economic Geology*, August) Schwartz emphasizes the as yet too little studied assortments of "clay" minerals and "micas," possibly both supergene and hydrothermal, which are environmental to many sulfide or once-sulfide ores, and in which tangible leads to ore applicable in the specific case might possibly be discovered. Such research is very much to the point. Especially since Nauk, USSR; Institute of Geological Sciences, Moscow, 1955. A history of the development "of the science of ore deposits" in Russia is followed by nine chapters discussing pegmatites as transitional between igneous rocks and veins, the genesis, chemistry and movement of hydrothermal solutions, paragenesis and habits of ores, metasomatic phenomena, etc. The approach and treatment appears to be chemical throughout. No translation in English is known.

Studies of living thermal springs such as occupy Donald E. White and such as he reviews in his paper, "Thermal Springs and Epithermal Ore Deposits," contribute field facts to geologists' unending speculation as to the chemistry and physics of metal bearing media.

Laboratory studied synthesizing minerals are reviewed by Weyl.

Like all industries, the mining industry is increasingly research-minded

laboratories now have equipment whereby to sort out and identify components of these difficult mineral assemblages which to the mine geologist, if he notes them at all, may be just "clay," "gouge" or "sericite." Schwartz's studies indicate the vast amount of field and laboratory work necessary if leads to ore are to be isolated and confirmed to a point of usefulness by work in many districts.

Current Philosophies Concerning Ore Deposits

A study of the iron content of sphalerite in the common orebody of the Star and Morning mines by Fryklund, Jr. and Janet Fletcher *(Economic Geology* for May), both of the Survey, lead them to conclude that the 6000-ft oreshoot formed at lower temperatures in its lower reaches than in its upper portion and that it may have formed from the top down.

The writer's attention was called to a compilation by six Russian authors used as a text in Russia: As translated, "Basic Problems in the Science of Magma-derived Ore Deposits," a second edition published by Akademy

Fleischer discusses the accumulating and more accurate quantitative knowledge of the minor and rare elements found in some sulfides, which may indicate conditions governing their deposition and thereby clues to new prospecting tools.

Ingerson outlines methods of estimating temperatures at which magmatic and wall rock processes may have proceeded. Lovering gathers together data and conjecture in the literature regarding temperatures in and near intrusions.

Anderson's "Oxidation of Sulfides and Secondary Sulfide Enrichment" reviews published thought and data on one of the two outstanding problems obstructing mining geologists in the field today, as much more detailed knowledge of the chemistry of the weathering and reworking of veins and sulfide ores under varying climatic and wallrock conditions. The other and logically the first and more urgent problem is the job of amassing field facts and dependable laboratory knowledge of the complex chemical steps in the genesis of the primary ores themselves.

Regional relations and groupings of mining districts have always interested geologists. A scholarly paper, "Metallogenetic Provinces and Epochs" by Turneaure assembles factors of mineralogical association, stratigraphy, geologic age and orogeny which may have obscure generic significance in numerous metalliferous regions of the world.

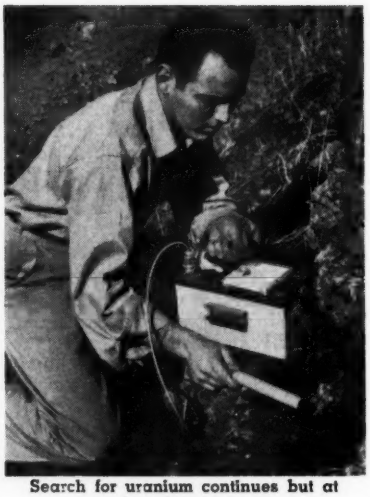
The foregoing seven papers and others in the Fiftieth Anniversary Volume of Economic Geology constitute a valuable expose of current fundamental research and thought concerning ore deposits. Unlike chemists the student of ore deposits cannot bring all his data and materials into a laboratory and set up rows of experimental test tubes. Time and means restrict his travels and hence his observation. Indeed, he has yet to devise "sampling" techniques and facilities enabling him to gather representative data in a single major district, to say nothing of a sufficient number of districts, to provide a basis for conclusions such as any biologist or physicist would consider safe. His problem is real and serious, and hence his too great dependence on the published observations and cogitations of fellow wanderers. Not if he lived to surpass Methuselah could he escape these inherent limitations on his observation as an individual.

Lack of Absolute Facts

All this emphasizes the lack and need in mining geology of the kind of first hand, full time, organized research such as has advanced knowledge in other fields.

Mining geology suffers through a lack of incontrovertible field fact gathered in a way to ensure its representativeness and potential significance. Many mining geologists wish this lack could be remedied before the hundreds of miles of workings in each of our major districts become completely inaccessible. They envisage a qualified task force with proper "sampling" methods, with convenient and constant access to a modern laboratory, with time and means to gather, systematically, representative data and material necessary to knowledge of the chemistry of our primary oxide and sulfide ores and their environmental alterations, and in their varied occurrence not in one but in many districts. The differences and variations would be as instructive as similarities and repetition. Geologists with mining companies are not equipped for such research.

Though field and laboratory research is traditional with the United States Geological Survey and much of its work is in the spirit of research, it is not organized for this task and its expanding responsibilities probably preclude it. A contemplated "sulfide laboratory," however, should add to the research value of its field work.



Search for uranium continues but at a less frantic pace

Energetic and able men in the universities and certain laboratories do much. But with most theirs is the part time work of individuals who have other duties. They work on projects which are actually only fragments of the problem as a whole. Unavoidably they work too much apart from the field. Excellent though much of their work is, it will be another generation before their collective efforts provide mining companies with incisive diagnostic knowledge effective in any specific exploration job.

This fact-gathering task would be a full time for coordinated teams of active men with modern laboratory facilities and technicians at their command. Five years at least and two or three million dollars would be necessary to make a good beginning. Properly shared this is not a large sum, and properly spent it could be the most profitable investment in exploration the mining industry could make. The best attack is a bold, full-front, full-time approach. With the problem properly posed and defined, a direct approach should win the nonferrous metal mining industry's interest. As already stressed the task is that of extending systematic observation through many districts, closely guiding field observation by concurrent laboratory analysis and observation. Chemistry and physics today promise geologists data not available to Lindgren, Emmons, Van Hise, and others of their day.

Minerals Research Institute

A movement is on foot to form and finance a so-called "Minerals Research Institute," which would be a legal entity governed by a board which would employ a director who would hire a small administrative group. It is planned that this organization stimulate and coordinate jobs of research directed to the study of mineral deposits—such work to be by qualified personnel in institutions, universities, surveys, and laboratories. The Institute would finance approved research of varied character but particularly research bearing upon the genesis of ore deposits by contract or other arrangement. The thought is that the governing board be drawn from industry, be advised by men of educational institutions and government, and that the National Science Foundation assist in the selection of consultants and advisors and possibly in initial financing, the cost later to be borne by industry.

Much good work could thus be stimulated and sustained. But there is a question whether the problem of the genesis of our primary oxide and sulfide ores could be faced squarely and dealt with as a whole. If a rather too academic view of it be taken, it might be dismembered into odd jobs of research farmed out as now to individuals, able but working too largely in their own laboratories and chosen bailiwicks. The result might then be only to augment the flow of papers describing the peckings of individuals at the fundamental problem.

Conceivably, however, the "Minerals Research Institute" could set up groups of full time closely integrated field and laboratory workers under such auspices and direction as could win industry's confidence and cooperation in facilitating work in mining districts.

Like all industries, the mining industry is increasingly research-minded. Many know our absolute, almost urgent, need for a far better understanding of the whence, how and when of our ores if we are to exhaust the districts we now exploit and look to the requirements of the future to assure our own burgeoning economy the great quantities of the common metals which, despite all substitutions, it increasingly consumes.

During the past half century mining geologists have become skilled geological and examining engineers and not research geologists. The able men in our universities do not have sufficient contact with our mines and districts. The facts in our mining districts of interest to the chemist, physicist and now the "geochemist"—to use an increasingly popular term—are not to be found in geological literature, on the maps, nor in the files of mining companies. It has always been difficult to enlist cooperative effort in research and other matters in the mining industry. Only a definite, directly pointed, adequate research program under competent, practical auspices will. The time may be at hand when the more prosperous of our mining companies may organize their own geological research staffs and laboratories, if some concerted effort in fundamental research in ore deposits does not soon get under way.

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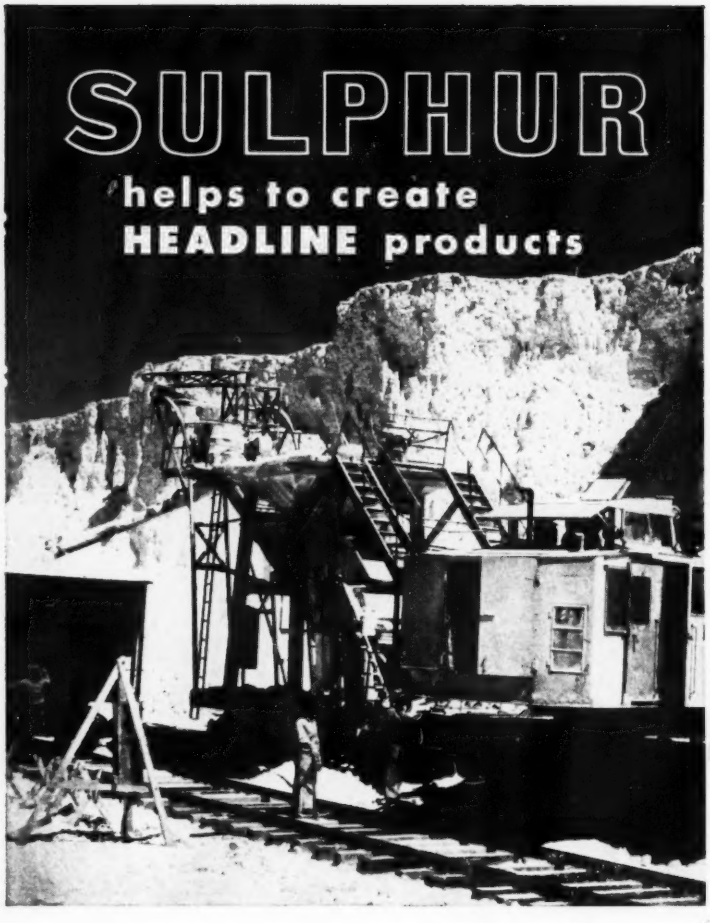

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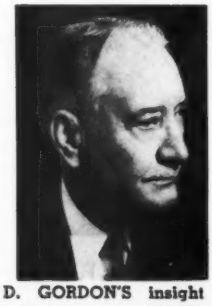
One quicksilver mine operated by the Cordero Mining Co. in Humboldt County, Nevada, accounted for practically all of the State's production, yet Nevada ranks second in the production of quicksilver

Strategic Metals

Without an improved Government minerals policy, the future of mining and processing strategic metals is not encouraging

By LOUIS D. GORDON
Executive Secretary
Nevada Mining Association, Inc.



LOUIS D. GORDON'S insight into the problems of mining gained in Nevada, Utah and California as a practical mining man and long time member of the executive committee of the Nevada Mining Association, Inc., particularly qualifies him to prepare the review on strategic metals in 1956. At present Gordon is executive secretary of the association.

THE definition of "strategic metals" has changed with the years. At the beginning of World War II, it included "minerals not produced within the United States in amounts necessary for military and essential civilian requirements."

Later, the classification of "critical minerals" was added, which included everything in relatively short supply, and both terms were applied, more or less, indiscriminately until the meaning of strategic and critical became confused.

In the past few years, the production of metals and minerals necessary for our "essential civilian and defense requirements" has increased. However, if the original definition is to be retained, then copper, lead, and zinc are strategic and so are other metals and minerals, with the possible exception of molybdenum and tungsten, which we produce, or can produce, in exportable amounts.

The metals and minerals not produced in the United States in amounts approximating our requirements do occur in quantities which might be considered commercial in some foreign countries, but our mine labor costs are the highest in the world and most metal and mineral deposits, except those of large, open pit, mechanized mines, must be above average world grade in order to be profitable.

Both of our major political parties apparently advocate, and are dedicated to, a policy of free trade and, consequently, tariffs on metals and minerals have been reduced to comparative insignificance.

Spiraling labor costs, plus current commodity prices and freight rates, plus free trade and a gold policy which permits foreigners to draw on our gold reserves as a medium of exchange but does not permit United States citizens to do so—all contribute to a declining production and the addition of more and more metals and minerals to the strategic class.

It would seem that, without some change in Government policy—and a halt to inflation—or an outright Government subsidy, the future of mining and processing strategic or critical metals and minerals in the United States is, to say the least, not encouraging.

Tungsten

The basic problem facing the domestic tungsten industry is over-production and under-consumption.

The Government purchase program, induced by the Korean War, increased production so much that we are now more than self-sufficient in tungsten.

In 1955 tungsten ores and concentrates, produced by United States mines, contained 15,669,000 lb of tungsten metal. Imports were 20,646,000 lbs and consumption 8,967,000.

For the first nine months of 1956, production equaled 10,696,000 lb of tungsten metal. Imports were 16,728,000 lb, and consumption 6,819,000.

Tungsten ore and concentrates imported during the month of September 1956, the latest month for which statistics are available, totaled 1,301,560 lb of contained tungsten metal. Imports, in the order of volume, were from the following countries: Bolivia, Australia, Canada, Brazil, Argentina, Peru, and Korea.

Congress realized the problem confronting domestic producers after the termination of a 3-million unit purchase program. As a result, in July 1956 Public Law 733 was enacted as an interim or stopgap program, or until consumption and production were more in balance and the domestic tungsten industry could stand on its own feet.

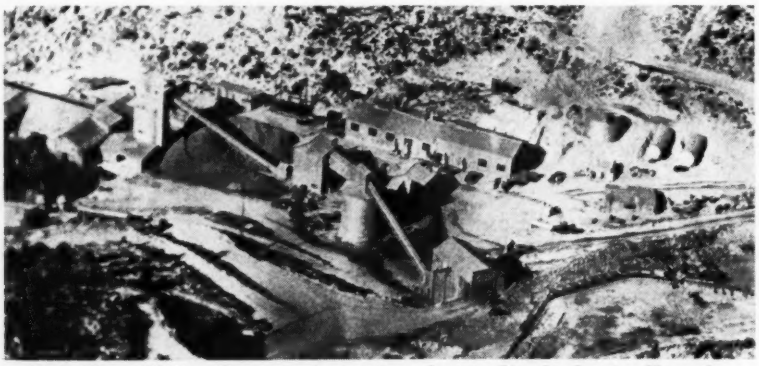
Public Law 733 provides for the purchase of 1,250,000 short ton units of tungsten at $55 per unit, with a limitation of 5,000 units per month from any one mine in any mining district. An appropriation of $21 million was approved, but was expended by the latter part of November 1956.

Of present concern to domestic producers is the need for an appropriation to complete the tungsten purchase program authorized by the last Congress and approved by the President.

In the meantime, an intensive research program, sponsored by The Tungsten Institute and directed by Dr. R. H. Thielemann of the Stanford Research Institute, resulted in the production of much higher temperature alloys through use of an increased percentage of tungsten. Dr. Thielemann has developed a new tungsten alloy known as WI-52, and blades and vanes for jet aircraft made of this alloy are now in the hands of leading aircraft manufacturers for testing. In addition, bars of tungsten metal are now being used to form cutting tools, whereas former tungsten shortage prohibited such use. Tungsten carbide has entered the attrition grinding field, including parts for hammer mills, balls for ball mills, liners for disc pulverizers and inserts for excavating equipment.

The use of tungsten carbide alloys in various types of drill, rotary, and coal mining bits is constantly expanding.

The Department of Defense has finally reversed a directive to "design around tungsten" in the production of high temperature alloys. This ruling was long overdue and will mean increased use of the metal by the Armed Services, and in the production of alloys for peacetime uses. However, the low world price for tungsten and large amounts of the metal available for import make the problem a complex one, as our Government has many tungsten purchase contracts with foreign producers, entered into at the time of the Korean War. This tungsten is for stockpile purposes, and, as the contracts are fulfilled, world production will complicate the problem even more.



Wah Chang Mining Corporation's tungsten plant in Lincoln County, Nev.—the basic problem facing the domestic tungsten industry is over-production and under-consumption

The basic solution is increased consumption, both in this country and abroad, if a long range, realistic price for tungsten is to be maintained and domestic producers permitted to survive. Otherwise, the only practical solution seems to be a protective tariff sufficient to enable domestic mines to compete against low cost foreign producers, assure us of an ample supply should an emergency arise, and, at the same time, permit American miners to maintain their present wages and standard of living.

In the meantime, it would seem that fairness and equity should be sufficient reasons for Congress to complete the appropriation authorized under Public Law 733, as domestic producers were given to believe that the full appropriation would be made and have depended upon it in making plans for future production.

Tungsten mining is one of Nevada's important industries, as we lead the Nation in tungsten production. Thousands of Nevada workers are dependent upon it for a livelihood and millions of dollars are invested in tungsten mines and processing plants.

Manganese

United States production of manganese ore and concentrates for the year 1955 totaled 288,700 short tons and, for the first nine months of this year, 253,700. Manganese ore imports for 1955 were 2,088,420 tons and, for the first nine months of this year, 1,662,330.

For the first nine months of 1956, imports, in order of volume, were from: India, Gold Coast of Africa, Union of South Africa, Cuba, Brazil, Belgian Congo, and Mexico.

In January 1956 manganese ore from various sources, on long term contracts, was quoted on the basis of 94c-96c per long ton unit of manganese c.i.f. United States ports, import duty extra. Indian ore was quoted at $1.12-$1.17 per long ton unit, import duty extra.

The latest available quotation for Indian manganese ore, c.i.f. United States ports, is $1.64-$1.69 per long ton unit, including export, but not import duty. Indian export duty averages about 13c per long ton unit. Higher ocean freight rates plus the stoppage of traffic through the Suez Canal are given as the principal causes for recent price increases. If the Suez Canal is not opened for several more months, further price advances may be in order.

Manganese is being purchased for the stockpile and last July ODM increased the amount to be purchased from 19 million long ton units to 28 million and extended the termination date of the program to January 1, 1961.

Nevada and Montana are producing 48 percent of the manganese produced in the United States. Manganese, Inc., of Henderson, Clark County, Nev., is the largest domestic producer of manganese. That company is now mining 1100 tons of crude ore per day which, after beneficiation by flotation, is processed into nodules. Current production is at the rate of 100,000 long dry tons per year of metallurgical grade manganese.

Domestic producers must be encouraged, and their output greatly increased, or we will continue to depend upon overseas sources for most of the manganese needed for our ever-increasing defense and industrial needs.

There are many deposits of manganese ore in the United States. Most of these are large, but low grade; requiring big capital investments for developments and facilities for processing the ores. However, shipments from India and other overseas sources could be cut off; so it seems that the problem, as far as manganese is concerned, is a real one. The only "safety factor" answer is to endeavor in every possible way to increase our domestic

Manganese, Inc., is the largest domestic producer of manganese, mining 1100 tons of crude ore per day

production and the production of our North and South American neighbors.

Quicksilver

Due to cartel operations and Government apathy, the quicksilver industry almost ceased to exist in 1948-1949. The general position of the industry does not show any apparent sign of major change in the next two or three years. Gradually increasing world production has seemingly been absorbed in increased consumption and additions to various national stockpiles, so that industry stocks have remained fairly constant. Foreign producers' stocks are reported to be low. The two largest foreign producers have increased their plant capacities, but lower grade ore and expected higher operating costs may keep their production somewhere near present levels.

Domestic producers of quicksliver have high operating costs and, for the most part, lower grade deposits, but are currently surviving.

A Government purchase program provides for the purchase of 300,000 flasks of quicksilver—225,000 flasks from domestic, and 75,000 flasks from Mexican producers, at a price of $225 per flask. No announcement has been made of the amount of quicksilver purchased, if any, under the program. The length of term established, and probably the price, may be sufficient to encourage present production, but not induce new production.

There should be an increase in demand for quicksilver in the years ahead, but the outlook for new major discoveries is not too encouraging.

Imports of mercury in the third quarter of 1956 totaled nearly 14,000 flasks, 20 percent more than in the preceding quarter. Of the imports, Spain supplies 45 percent, Italy 26 percent, Mexico 22 percent and Yugoslavia 2 percent. Other exporting countries were Chile, Peru, and the United Kingdom. Imports from the United Kingdoms were said to be reexports, as the United Kingdom is not a mercury producing area.

Industrial consumption in the United States in the third quarter was 12,300 flasks, compared with 11,700 flasks in the second quarter. Domestic production for the third quarter was 6300 flasks, the highest quarterly rate since the corresponding period of 1946.

Fourteen United States mines produced 89 percent of the domestic output. Alaska production came from one mine; California from seven mines; Idaho from two; Nevada from two; and Oregon from two. One mine in Nevada, the Cordero in Humboldt County, accounted for practically all of Nevada's production, yet Nevada ranks second in the production of quicksliver.

Antimony

Domestic mine production of antimony is at the rate of from 550 to 600 tons per year, or about 5 percent of United States peacetime consumption of primary antimony (approximately 12,500 tons per annum). Production is limited almost entirely to a by-product output of the Sunshine, a silver mine in Idaho. Other domestic producers are unable to compete against low cost imports in the absence of adequate tariff protection.

The Yellow Pine Smelter of the Bradley Mining Co. (formerly the largest domestic producer of antimony), at Stibnite, Idaho, is being maintained for custom work only. The milling plant of the company is being dismantled and sold.

Domestic consumption of antimony for the first nine months of this year is given by the United States Bureau of Mines as 8800 tons, of which 57 percent was used in the manufacture of nonmetallic products and 43 percent in the manufacture of metal products.

Imports for the first nine months of 1956 were about 9000 tons as against 8900 tons in the first nine months of 1955.

The largest exporters of antimony ore and concentrates were Mexico and Bolivia. Mexican exports to the U. S. contained 2146 tons of antimony and Bolivian, 926.

In addition, we imported 501 tons of antimony metal from Mexico, 659 tons from Belgium-Luxembourg, 1084 tons from the United Kingdom, and 790 from Yugoslavia. Appreciable quantities of ore and concentrates were exported to this country from Algeria, Canada, and Peru; and in the second and third quarters of this year, the Union of South Africa shipped us ore and concentrates containing 1042 tons, and 648 tons, in the form of oxide, were imported from the United Kingdom.

Considering the fact that most of our antimony is coming from oversea sources, it would be noticeable for its almost complete absence in the event of a sudden emergency.

The Federal Government is buying antimony metal for stockpile purposes, from foreign sources, largely by "barter" deals, and also from domestic producers—principally, the Sunshine by-product output.

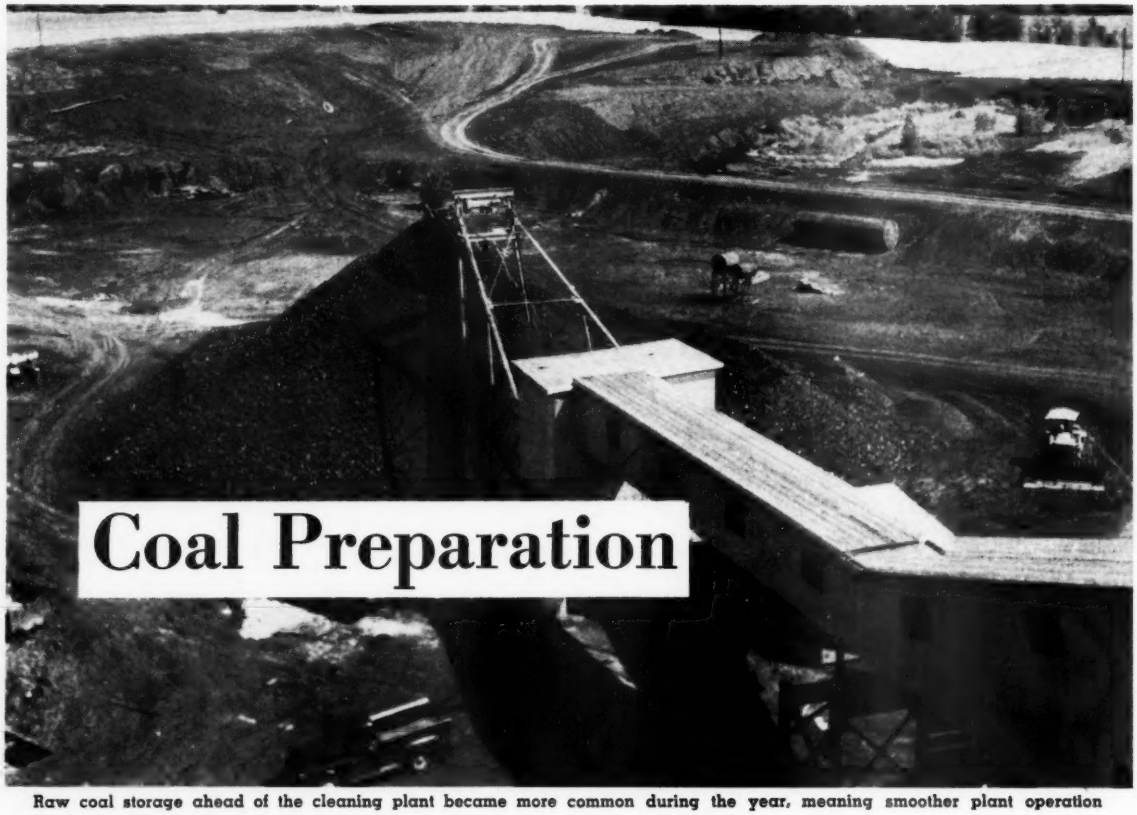
However, the policy is not to pay more than the going world market price for antimony, which, in view of low cost foreign production, offers very little inducement for the expansion of the domestic antimony industry.

Chrome

It is estimated that the 1956 production of domestic metallurgical-grade chrome will show an increase of around 30 percent over 1955. California's production is estimated at 25,000 or more short tons (1955 production of 22,500 short tons); Oregon's at 10,000 short tons (1955 production of 5000 short tons); and Alaska's and Washington's at 4000 short tons and 100 short tons respectively. Production of low-grade chrome from Montana, the Nation's largest chrome producer, is expected to be maintained at its annual rate of around 110,000 short tons. Montana's low-grade concentrates were sold to the Government under terms of a special contract, and the metallurgical-grade chrome of the West Coast was purchased by the Government under the act for stockpiling strategic and critical materials.

In response to hearings before the Senate Subcommittee on Minerals, Materials, and Fuels held last April and May, Office of Defense Mobilization Director Flemming authorized a two-year extension of the chrome purchase program for metallurgical-grade chrome until June 30, 1959. In addition, a plan for carload purchases under the program was announced August 8 in the "Federal Register" by General Services Administration. Although the chrome producers welcomed the extension and carload modification, the time limit and amount left to be purchased (now less than 70,000 long tons) discourages expenditure that would set up a well-planned mining venture. Consequent-

(Continued on page 140)



Coal Preparation

Raw coal storage ahead of the cleaning plant became more common during the year, meaning smoother plant operation

Increased recovery and a high quality product were the goals as the emphasis was placed on "total" cleaning

By R. L. LLEWELLYN
Preparation Engineer
Eastern Gas & Fuel Associates

In 1936 R. L. LLEWELLYN joined the Koppers Co. and was sent to the anthracite field to learn laboratory procedures and operating practices before entering Koppers' engineering and construction department. Later he joined Island Creek Coal Co. in Holden, W. Va., where he spent eight years in design and construction engineering for them and their subsidiaries. In 1946 he joined Eastern Gas & Fuel Associates and has since worked with the many coal handling problems of the company's 16 mines located in West Virginia and Pennsylvania.

In addition to his many other duties, Bob is chairman of the Coal Preparation Committee of the American Mining Congress.

COAL continued on the upswing in 1956 and with the innate optimism which accompanied this upswing, new mining expansion programs became realities. Cleaning plants which had been on the drawing boards, some of them for quite awhile, saw completion and became a definite part of the unique material handling system from inside the mine to the railroad cars on the outside. Existing cleaning facilities were expanded to improve production and efficiency. Operators were more cognizant of maintenance problems and costs, and utilized special materials in plant construction to increase the equipment life. The customer's individual requirements for quality of the product was emphasized in tailor-made and individually designed plants.

Raw Coal Handling

Raw coal storage bins and stock piles received emphasis during the year to assure continuity of operation and smoother cleaning plant performance. Traveling tripper belt conveyors were used at one plant on top of the bins to provide blending of the raw coal into separate compartments. Individual feeders under each compartment measure the amount of coal removed from each bin to provide the ultimate in blending ahead of cleaning facilities. This same plant located in northern West Virginia, has a 5000-ton storage capacity in a concrete structure with all conveyors for blending operating in a completely automatic cycle. Another plant under construction, will have a 15,000-ton ground storage. Storage facilities capable of handling 1000 to 2000 tons were not uncommon.

Crushing run-of-mine with rotary

type breakers and especially built crushers to control the top size in the plant feed was another feature of 1956. The trend was to eliminate hand-picking on lump size. One type of single roll crusher for this purpose has been developed with pin wheel segments and a matching breaker plate to eliminate the passing of large flat slabs of refuse through the unit. Another type installed was a "slugger" crusher with extra heavy manganese hammers to break the material to size by attrition. Still another type used was a double roll crusher without springs to prevent oversize in the crushed product. All of these crushers were heavily constructed to withstand wear.

Coarse Coal Wet Washing

Heavy density units using finely ground magnetite saw wider use to clean a pre-sized feed at a selected specific gravity. While the vessels were dissimilar in design, their medium recovery systems were also different. In some cases demagnetizing coils and densifiers were omitted, cyclones and thickeners were installed—all to reduce the cost of installation without loss of efficiency in magnetite recovery. One unit has the feature of making a two gravity separation. Prefabricated washers were installed to handle smaller tonnages. Several operators found a sizable financial return with a relatively small capital expenditure by recovering coal losses in the refuse from existing washers by using rewash units.

Heavy density washers using sand and water were installed at several large cleaning plants. Most notable of these plants was the one built in Kentucky in which several features were introduced to improve maintenance, performance, and over-all results. The method used for desilting was a continuous process using a German radial screen in the sand cone circuit which received slurry from the clean coal desanding screen. It features no power requirements because the only moving part is propelled by the entering pulp. With continuous desilting, there is no need to purge the system periodically to remove excessive build-up of fine solids which affects the washing gravity. At another plant experiments have been made using a "torque flow" pump to handle the refuse from the sand cone to eliminate a high maintenance elevator. Special rubber lined pumps have been used to handle the abrasive sand and water with reported lower maintenance costs.

Baum jigs were used for cleaning both unsized and sized feeds with a wide tonnage range. Larger units were capable of handling 600 to 800 tph of feed. Continued improvements were made on air controls and elevator chains to reduce maintenance. Highly successful results were reported on washing fine coal with the coarse size in Baum jigs.

Fine Coal Cleaning

Both wet and dry plants were built during the year to clean the fine coal. One sizable plant with concentrating tables utilized bowl desiltors to eliminate 100-m by 0 slimes from the table feed. Desliming ahead of wet washing fine coal is not new, only the use of the desiltor, which is similar to a rake thickener, can be considered a recent innovation. At other plants screens, cyclones, and large settling tanks or cones have all been used to deslime. The wasted 100-m by 0 fines are generally high in ash and sulphur; and when removed from the system, improvements in cleaning, dewatering and drying results are obtained. Announcement of a new idea will soon be made regarding table plants which will affect the initial cost by reducing the space requirements in the structure.

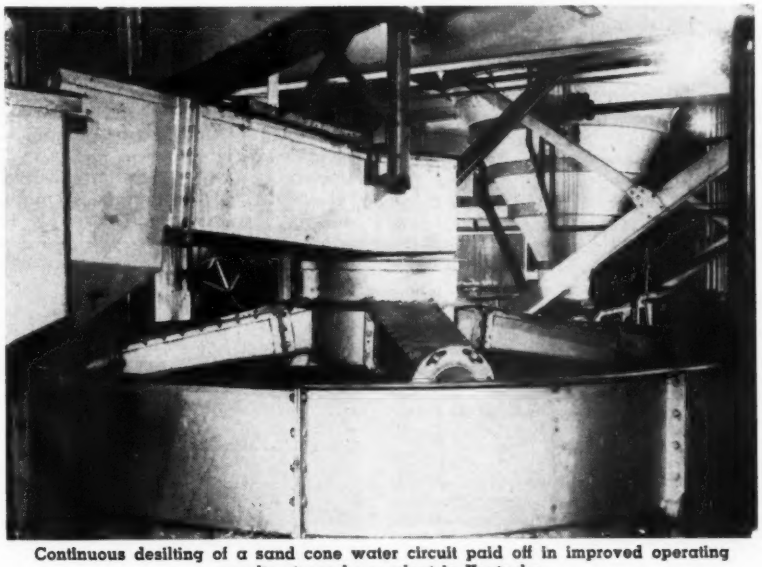
Another new plant was placed into operation using Baum jigs and tables, a segment of the fine coal being recleaned on the latter for increased recovery and improved cleaning results. Another plant featured the combination of Rheolaveur launders and tables, the latter recleaning the refuse for maximum recovery.

Air cleaning plants with varying capacities were constructed in 1956. Smaller operators were able to upgrade their fine coal with only one air table. At one larger air plant involving four units, the fine coal is predried in thermal dryers before cleaning. Another feature in this plant is to retreat the middlings from the air tables in a Hydrotator. A heavy medium washer was successfully used for the retreatment of middlings which had been screened at ⅛ in. A new mobile fine coal jig unit was used experimentally to clean middlings and refuse from an air plant. This unit is offered on the basis of customer's satisfaction of results or return the jig without obligation.

Dewatering

Removing water from the coal after washing occupied a position of primary importance in many new plants and represented a sizable expenditure for the equipment involved. Dewatering of coal on Parrish type and vibrating screens was the general practice followed by centrifuging on the finer coal sizes. Good moisture reduction was reported on centrifuged products from both the solid bowl and screen type centrifugal dryers. Where desliming was accomplished, the results were even better than predicted. After one screen type centrifuge from Europe was installed at a mine in northern West Virginia, two more units were placed in a new plant in the same area to handle ¼-in. by 0 wet washed coal. Reports have indicated excellent moisture reduction and high capacities. This unit features minimum degradation and effluent losses, and uses only ⅛ hp per ton of product. Screen life is estimated at 2500 hours based on results on European installations of which there have been 80 in the past two years. A study on centrifugal drying has recently been completed by the Coal Preparation Committee of the AMC Coal Division and will be published in the March issue of MINING CONGRESS JOURNAL. It gives data on operation, maintenance and performance.

A horizontal filter was introduced to dewater more friable coals with



Continuous desilting of a sand cone water circuit paid off in improved operating results at one large plant in Kentucky

minimum degradation. This unit has certain advantages over the high speed dewatering machines where there is concern for breakage. The formation of extreme fines causes further difficulties in water clarification systems and in air pollution.

Activity in water clarification equipment has been increased due to Stream Pollution legislation. Cyclones to filters, and thickeners to filters were two of the combinations installed at various plants to recover coal from the water circuit and condition the product for the market. The solid bowl centrifuge was also used for this purpose at several plants. One large plant has a European process using oil to treat the coal slurry before centrifuging. This was introduced to the coal industry a few years ago.

Some operations are successfully pumping fine solids and plant bleed to settling areas while others are using flocculation to treat the water for reuse. Nearby settling ponds were popular to dump the system in an emergency but are costly and troublesome to keep cleaned out if used to handle the regular plant bleed.

Thermal Drying

Stoker coal sizes were dried in down draft, screen type units which have been used for this purpose for 25 years. However, the greatest tonnage thermally dried was in the fine coal sizes after wet washing. It is difficult to realize that the vertical stack flash dryer was developed 20 years ago. For about ten years there was little interest in drying fines until it became necessary to upgrade the slack which was produced by mechanized mining methods. The cascade multi-louvre dryer was developed about this time for the same purpose.

A tremendous interest in fine coal drying was then started in the industry and continues today as evidenced by new and contemplated dryer installations. Other dryer types have been developed and successfully placed into operation. An operator now has a selection as to which type will solve his particular drying problem and fit into his plant design and appropriation.

An air cleaning plant in West Virginia was installed with an additional multi-louvre type dryer for predrying ⅜-in. by 0 coal. Three of the same type were installed at a large plant in Kentucky to dry ¼-in. by 0 after wet table cleaning. It is interesting to note that the former dryer was enclosed in a structure while the latter three units were not. Dust from the primary dust collection cyclones were used for furnace fuel at both plants. These dryers are provided with a feature to cool the product at the discharge end of the unit.

The majority of the vertical stack flash dryer installations have been in wet cleaning plants. Only two applications for predrying prior to air-cleaning have been made. However, this type of dryer was also used at power plants and is now being considered to dry anthracite coal at a proposed power station. Considerable interest is directed toward the nearly completed coal pipe line project where the flash dryer installed at the terminal will reduce the filter cake moisture so that it can be used in the pulverized coal burning equipment.

There are two other new developments which are noteworthy: The "coal trap" is a feature used for softer coals where degradation is a problem in that the coarser fine coal is collected separately without cyclonic action. "Dedusting" is a feature used to reduce vent losses and at the same time provide a fuel for the furnace from dust that would otherwise be wasted.

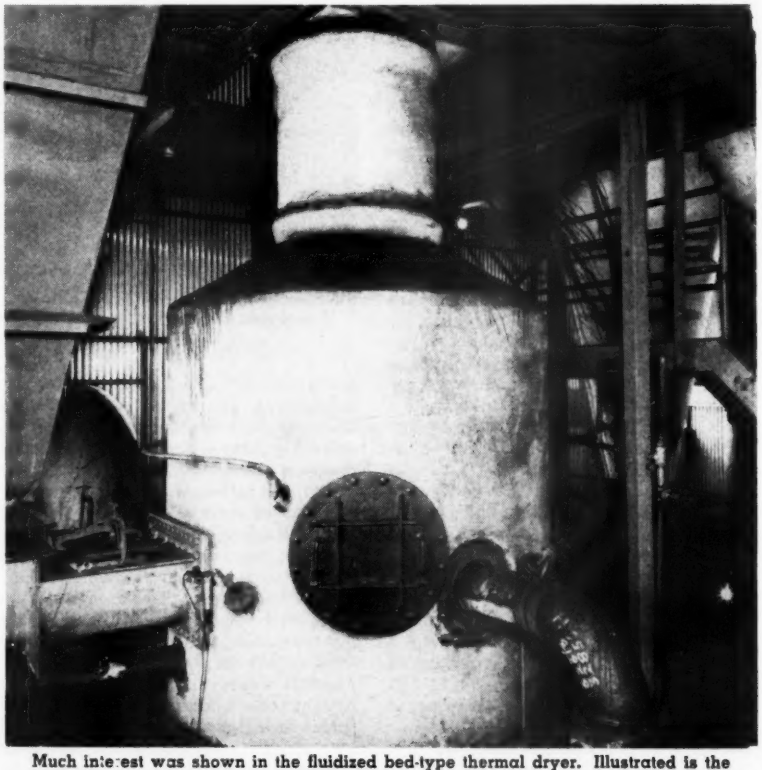
The fluidized bed fine coal dryer has attracted wide attention and is being considered for many proposed preparation plants following a successful installation in Indiana. High drying efficiency is obtained from ideal conditions in the fluidized bed. Larger capacities can be dried at low velocities and air volume in a single unit which is controlled by instrumentation.

Another manufacturer has developed a new fluid bed dryer for fine coal which features low degradation of coal, low maintenance and simple operation. Controls are not elaborate yet effective for proper operation. A pilot installation in Pennsylvania has been drying coal for about 18 months.

Dust collection units of the water type were used for secondary collection on the vertical stack flash and multi-louvre dryers where the vent losses were a problem due to plant location. Wet type dust collectors, rubber lined for corrosion control, were installed at several cleaning plants—three in Kentucky, two in West Virginia, eight in Virginia and four in Ohio. The latter is for the coal pipe line project.

A new wet collector was developed by a manufacturer and will be used on a coal installation early in 1957. This unit is made of stainless steel to provide protection against corrosion. All successful wet collectors depend upon centrifugal force to intermix water and dust-laden air which affects the efficiency of collection. From an operating standpoint, the quantity of water used, horse power requirements and amount of maintenance are also important factors.

Total cleaning was emphasized throughout the past year in the new preparation plants and in existing plants where fine coal cleaning units were added. Operators sought to provide customers with a high quality product and at the same time increase coal recovery. It is expected that construction of preparation plants will continue at an increased tempo through 1957.



Much interest was shown in the fluidized bed-type thermal dryer. Illustrated is the drying compartment of such a dryer. Feed bin and feeder are visible at the left

Agricultural grade muriate of potash in 100-lb sacks goes by conveyor from loading machines into boxcar at Trona, Calif., plant of American Potash & Chemical Corp.

Potash in 1956

Industry continued program of modernization and expansion as a newcomer prepared to enter field

By DEAN R. GIDNEY
Vice-President & General Manager
United States Potash Co.

DEAN R. GIDNEY joined United States Potash Co. in 1937 and was appointed vice-president and sales manager in 1952. He held that position until July 1956 when he was elected vice-president and general manager of United States Potash Co., Division of U. S. Borax & Chemical Corp.

MAJOR achievements of the American potash industry during 1956 may be summarized generally as the establishing of a new record for the production and refining of potash salts as well as for deliveries, and a continuing program of modernization and expansion of production facilities.

The American potash industry consists primarily of five producing companies in the Carlsbad, N. M., area which mine potash-bearing ores from underground deposits, and two companies located in California and Utah which produce potash from brines. A sixth company in the Carlsbad area will commence production early in 1957.

In addition, it was announced recently that a seventh company, the Farm Chemical Resources Development Corp. (owned jointly by the National Farmers' Union, Kerr-McGee Oil Industries, Inc., and Phillips Chemical Corp.) would commence shaft sinking operations in the Carlsbad area early in 1957.

According to the American Potash Institute, deliveries by the seven domestic producers and importers during the first nine months of 1956 were approximately three percent greater than for the same period in 1955. Deliveries for agricultural use in the United States, Canada, Cuba, Puerto Rico and Hawaii for the nine-month period of 1956 were less by one percent than in the corresponding period in 1955, whereas deliveries for chemical use and exports outside of North America showed increases of 13 percent and 74 percent respectively.

If the indicated trend in deliveries continues to prevail during the final quarter of 1956, total deliveries for the year 1956 should be approximately 2,270,000 tons K_2O, which would be a new record. The indicated over-all increase in deliveries, while being much smaller than in the previous year, was accomplished in the face of estimates of lower fertilizer deliveries during the 1955-56 fertilizer year. For example, the National Plant Food Institute has estimated that fertilizer deliveries during the 1955-56 fiscal year will be down by approximately 4.4 percent, although they estimate that total use of primary plant foods (of which potash is one) will be as great as or greater than in the previous fertilizer year.

Canadian Deposits

Interest in Canadian deposits located in the Province of Saskatchewan continued to be extremely active with all American companies acquiring, exploring and/or developing holdings in that area.

America Potash and Chemical Corporation

American Potash & Chemical Corp., whose plant is located at Trona, Calif., produces potash from the brines of

Searles Lake and supplies the major share of potash used in the western States.

Productionwise, American Potash & Chemical Corp. expanded its Trona facilities to result in a 50 percent increase in its granular form of potash as opposed to the crystalline form as it comes from the plant. The granular potash has been found desirable for certain types of mixed fertilizers. A further 50 percent increase is now in the building stage and will be completed by April 1957.

To accomplish its plans for expansion and development, the company has laid out a $3,500,000 program, of which approximately $350,000 has been spent on new storage and loading facilities for potash at the Trona plant. Included in the new additions are a 7500-ton storage silo and loading capacities ranging from 100 tons-per-hour for bulk loading to 20 tons-per-hour for bag loading.

National Potash Company

Construction work at the new mine of National Potash Co., which will be the sixth producer to locate near Carlsbad, proceeded on schedule during 1956 and shipments are expected to begin early in 1957. National, which is owned jointly by Freeport Sulphur Co. and Pittsburgh Consolidation Coal Co., took over leases obtained by Freeport in February 1955 and work on the mine began shortly thereafter.

Two circular shafts, concrete lined and 15 ft inside diameter, have been sunk to the 1700-ft ore level—deeper than potash has yet been mined in this country. A 21-mile water pipeline was completed to the plantsite and is in operation, and the refinery and other above ground facilities are almost complete. They will include three hemispherical storage buildings with a total capacity of about 100,000 tons. Provision has also been made for rapid loading of the bulk or bagged product into covered hopper cars or standard box cars.

The $19,000,000 project is designed to produce 400,000 tons annually of muriate of potash containing 60 percent K_2O equivalent.

Duval Sulphur and Potash Company

Underground, Duval Sulphur & Potash Co. extended its main line belt conveyors and installed additional feeder belts from new panel areas.

Mine production was facilitated by the addition of two diesel-powered units underground; namely, a runabout for the mine foremen's transportation and a truck for the transportation of mine maintenance employes.

Severe geologic structural irregularities encountered during the year necessitated some modification of mining plans. Mining operations were otherwise routine, with a production schedule of two shifts per day seven days per week continuing throughout the year.

U. S. Potash began constructing a haul road on the surface over which to move ore six miles from its new Shaft No. 3 to the refinery at Shaft No. 1

No significant changes were made in the refining operation. However, in an effort to meet increased consumer demand for a granular product, Duval began an intensive plant testing program of a compactor designed to produce this type of product. As conceived, the compactor and related equipment will take, as feed, any or all of the fine fraction of the standard muriate of potash and will produce a high-quality granular material sized to demand.

International Minerals and Chemical Corporation

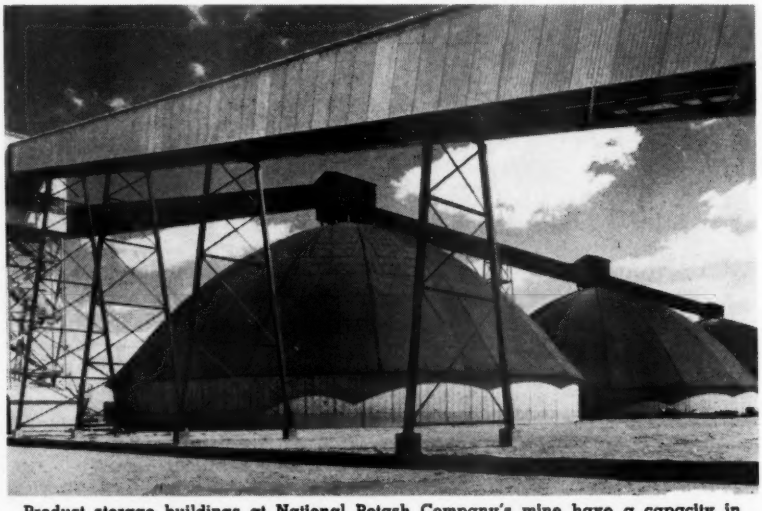
Developments during 1956 at the International Minerals & Chemical Corp. mine and refinery near Carlsbad have been aimed at increasing over-all production and improving efficiency by a substantial number of minor changes rather than any large development.

Underground, shortwall-type undercutters have been replaced with universal cutting machines in all production areas. All jumbo drills have been converted to one-man operation. Brake cars using streetcar type magnetic rail brakes have been installed to allow greater speeds on downhill hauls and releasing locomotive equipment for other hauls. Self-powered man-trip cars have been added in order to increase the face-time of production crews and the use of diesel-powered equipment underground has been expanded to cover practically all vehicles carrying blasting supplies, tools, lubrication equipment, and general maintenance items, particularly into areas not served directly by rail haulage. It is expected that conveyor belts will be installed in some panel areas during 1957.

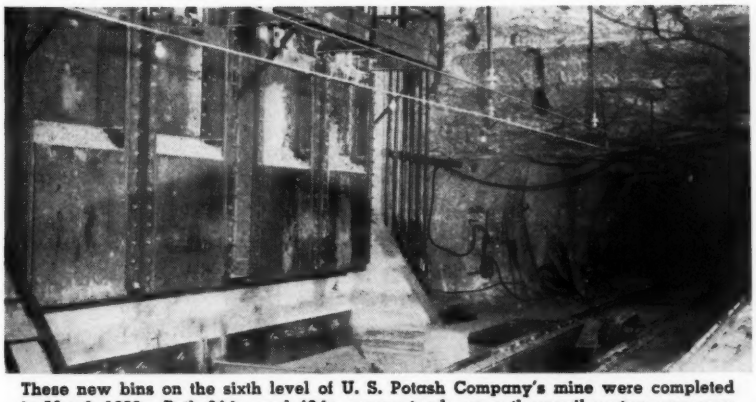
On the surface, all changes have been designed to provide for the handling of increased ore tonnage at optimum efficiency. The installation of equipment to provide for additional production of potassium sulphate was completed during 1956.

Potash Company of America

During 1956, Potash Company of America substantially completed its program of design and construction of continuous miners. In addition to four Joy continuous mining machines, the company now operates four Model 150 PCA miners and seven Model 200 PCA miners. Paralleling this program, some seven miles of belt conveyor have been placed in service, replacing both panel and mainline track haulage in certain of the operating sections. This modernization program makes it possible for the company to produce the major portion of its ore with continuous mining methods.



Product storage buildings at National Potash Company's mine have a capacity in excess of 100,000 tons. National expects to be in production early this year



These new bins on the sixth level of U. S. Potash Company's mine were completed in March 1956. Both 24-in. and 42-in. gauge track, on a three-rail system, run over the pocket, accommodating both bottom dump cars and narrow-gauge side dump cars

In adjusting to changing customer preference in products, PCA expended something in excess of one million dollars on additional surface plant facilities. A large increase in chemical grade muriate production facilities was provided. Although not related to agriculture, expansion in the industrial electrolytic industry created an increasing demand for this grade of muriate. In addition to providing facilities for increased output of certain grades, product improvement was an integral part of the surface program.

Potash deliveries continued to be seasonal in nature and it was necessary for the company to construct additional muriate storage facilities. A 100,000-ton unit, rather unique in nature, was completed. Laminated wooden arches were substituted for the conventional steel rib sections.

Substantial progress was made by PCA on its Canadian project as ground freezing operations were completed and actual shaft sinking undertaken. At the year's end, sinking was progressing satisfactorily. An engineering-construction contract for surface plant facilities was let at mid-year, and engineering-design work is moving forward.

Southwest Potash Corporation

During the year Southwest Potash Corp. completed construction to modify and expand milling facilities. This program, which began in 1955, was the first major construction undertaken since operations began in the fall of 1952. The program consisted of modification and expansion of the crushing section, preparation and flotation sections, and finished product section of the plant. Most outstanding, from the milling point of view, was the introduction of dry screen sizing of the incoming feed. Screen undersize constitutes finished plant feed suitable for subsequent treatment in the preparation (desliming) and flotation sections. The conventional rod-milling step was thereby entirely eliminated. Screens are in closed circuit with the tertiary crushers for further reduction of the screen oversize.

Considerable progress has also been made with regard to controlling, recording, and indicating instrumentation throughout the plant. These instruments serve well to assist the over-all operating routine and are contributing to an increased efficiency in the respective operating cycles.

Underground mining by the modified room-and-pillar method was continued, following the pattern prevalent in the Permian Basin. Initial mining was completed in certain parts of the mine, and secondary mining commenced in those areas in accordance with previously formulated plans. Results to date have come up to expectations.

To counter the advance of working faces farther away from the shafts, trolley man-trip cars have been introduced for transportation of working forces underground. These locally manufactured vehicles are equipped with dynamic brakes, mobile telephones, and first-aid supplies.

United States Potash Company

As the result of a merger with the Pacific Coast Borax Co. on July 2, 1956, this pioneer producer of potash in the Carlsbad area became the United States Potash Co., Division of United States Borax & Chemical Corp.

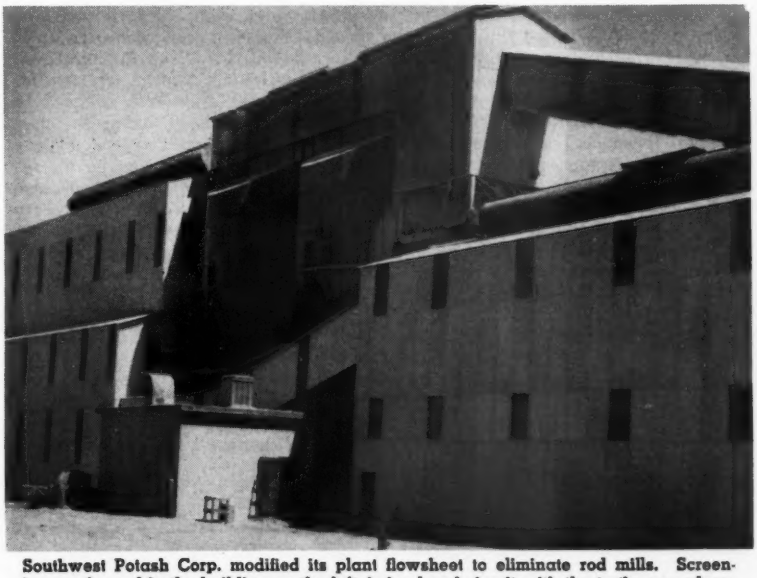
The year 1956 was marked by a very heavy construction program at United States Potash Co. The $3,000,000 expansion program to increase production by approximately 20 percent which was started in mid-1955 was completed during 1956. Construction was started on a new warehouse with 100,000-ton capacity.

Work was started on the mining facilities at Shaft No. 3, six miles north of the original shaft. Continuous miners and conveyors will be used.

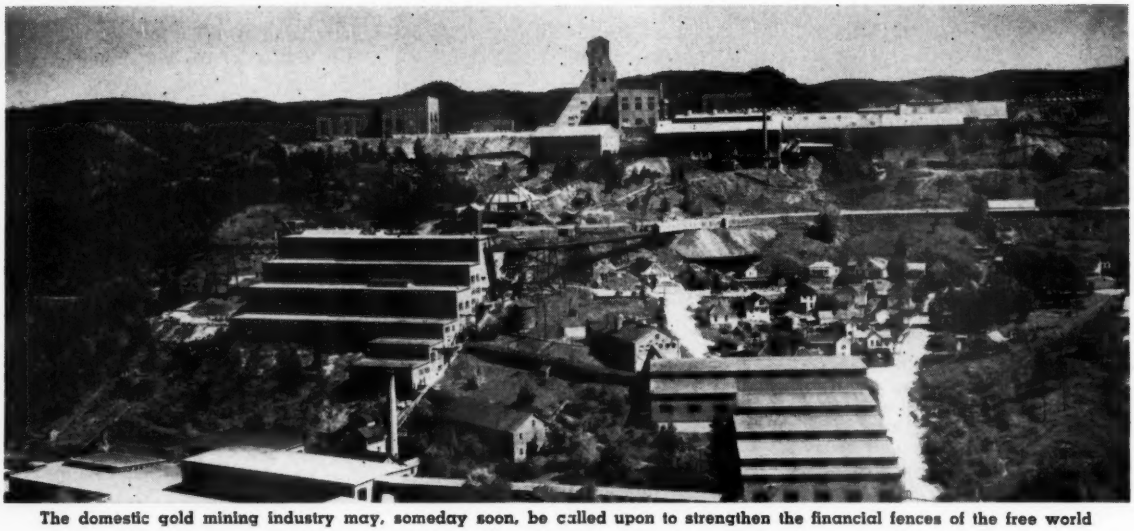
Construction was started late in the year on a company-owned road to connect Shaft No. 3 with Shaft No. 1 and it is intended to transport the ore from Shaft No. 3 to Shaft No. 1 by 50-ton capacity diesel trucks for eventual processing at the present refinery.

Two new plant additions were in progress at the year-end and will provide facilities for the production of a new high analysis granular product and chemical grade potassium chloride. It is expected that these products will be available by mid-1957.

Exploration work was carried on in Canada during 1956 and application was made late in the year for two permits comprising approximately 200,000 acres of Crown lands.



Southwest Potash Corp. modified its plant flowsheet to eliminate rod mills. Screening, performed in the building on the left, is in closed circuit with the tertiary crushers, in the building on the right



The domestic gold mining industry may, someday soon, be called upon to strengthen the financial fences of the free world

What About Congress And Gold?

The domestic gold mining industry finds itself at the brink of death in a land of plenty

By LOUIS L. HUELSDONK
Secretary-Treasurer and General Manager
Best Mines Co., Inc.

LEWIS L. HUELSDONK sketches the plight of the gold mining industry for Mining Congress Journal readers. A member of the Western Governors Mining Advisory Council, he has served as chairman of the California Gold Committee and as gold co-chairman with Dr. D. H. McLaughlin. He is also general manager and secretary-treasurer of Best Mines Co., Inc., which operates gold-silver-copper-lead-zinc properties.

Having recently visited Europe where he discussed gold problems with many leaders, Huelsdonk is exceptionally well prepared to write the review on gold for 1956.

CONFUSED research and official opposition have complicated the problem of "gold revaluation" to such an extent that Congressional investigation must be called upon to protect the interests of the public. This belief deserves consideration, because legislative action on 24 golds bills subsequent to World War II has lacked the punch to command a recognizable interest by more than a handful of the law-makers. A thorough Congressional investigation would not only open the way for honest appraisement, but it should also cut down the feeling of indifference accorded this subject in Washington.

Leaks in the Managed Money System?

A gold crisis is inevitable—because long overdue adjustments have not been made to balance the spread between the economic value of gold and the official price paid for it in terms of the inflated dollar. This maladjustment, which crippled the entire domestic gold mining industry, has reached out in many other directions which should be scrutinized. For instance, prior to World War II industrial users required a yearly average of less than $500,000 worth of gold to supply their needs. During the first full year of major warfare (1940) over $4,000,000 worth was purchased for this alleged purpose, and demand rapidly claimed enormous yearly increases until in 1946, $137,133,857 worth of the metal was sold by the Mint and private smelters (under Treasury Department licenses) for industrial, professional and artistic uses (see chart). It was ironical that the government closed the gold mines under WPB Order L-208 with the statement that gold had no strategic value in a war economy—and then sold, on a yearly basis, over 270 times the peacetime requirements during a war economy. It was also ironical that these sales, at $35 per ounce from monetary stock, exceeded the domestic production and occurred at a time when foreign free market prices were tremendously high. Who granted these special privileges and why? Was strategic use shown for this gold? Were smuggling operations involved? Were income taxes evaded? Even at this late date, Congress should look searchingly into these questions and find the answers.

U. S. Reserves Threatened

Today many phases of the gold question demand the attention of an alert and responsible Congress because over 90 percent[1] of the world's present production is being channeled to central banks and governments for use in the control of currency and trade. International and banking alliances have built a wall against an official price increase by a policy which morally obli-

gates the United States to hold the price down as a responsibility to the rest of the world. This allows a foreign build-up of gold and dollar reserves with long-range aims toward equilibrium of monetary reserve-backing and ultimate convertibility. Good banking practice dictates that more dollars be held than gold because dollars draw income; and with proper short-term investments, these can readily be redeemed in gold at the official price from the United States Treasury.

The merits of such a policy cannot be challenged from an international viewpoint. However, it poses a threat to the gold of the United States over which Congress should stand guard. The December 1956 Treasury Bulletin shows that short-term banking liabilities to foreigners rose steadily from 10½ billion dollars at the end of 1952 to over 15 billion dollars by October 1956. Simple arithmetic indicates that at this rate the total United States gold reserve of nearly 22 billion dollars could, theoretically, be taken by foreign demand within six years. This is only a threat now, but it will probably substantially materialize just prior to a general call for "gold revaluation" which will enhance the position of the foreign central banks—first, by the accumulation of American gold through conversion of their dollar holdings; and then by the sell-back of the "revalued" official gold for a proportionate increase in American dollars. Who can say that such a manipulation is wrong? America would get her gold back and the foreigners would get extra dollars which might otherwise be given them in the form of aid programs. However, it seems like a matter for Congress to look over.

Cheap Gold Helps Russia

A review of the disturbing gold question would not be complete without comparing Russia with the free world. The present low price for gold is lending progressive advantage to Russia. First, because the increased production costs in the free world have prevented a proper ratio of gold production to the increase in population and anticipated cost rises for future production will further maladjust this position. Second, because, with slave labor, costs do not affect Russian production materially. Besides having the second largest reserve in the world (now estimated at 7.3 billion dollars[2]), she has become the second largest producer with an annual estimated output of 13.2 million ounces, including production from her satellites. Most European officials agree (even in the face of the Hungarian situation) that this cheap gold is good for Russia and good for Europe, as it allows Russia to purchase imports which she and her satellites need and provides trade which the European needs. Russia could not materially increase her gold production under the influence of a price raise, for her capacity is tied to her present physical ability to increase mining facilities. In other words, no matter what the price, her present all-out effort is her limiting factor; whereas the free world could multiply production by many fold through the resumption of closed operations and by the mining of present marginal ores.

This should be a matter of deep concern to Congress since the present status points to a definite trend toward more and more confidence in the Russian ruble.

And finally, the domestic gold mining industry finds itself at the brink of death—under an exclusive 15-year-old depression—in a land of plenty. Congress should move immediately to revitalize this important industry which may, someday soon, be called upon to strengthen the financial fences of the free world. This could be no stronger illustrated than by the words of President Eisenhower in his State of the Union Message to Congress—

"I believe the time has come to conduct a broad national inquiry into the nation, performance and adequacy of our financial system, both in terms of its direct service to the whole economy and in terms of its function as the mechanism through which monetary and credit policy takes effect."

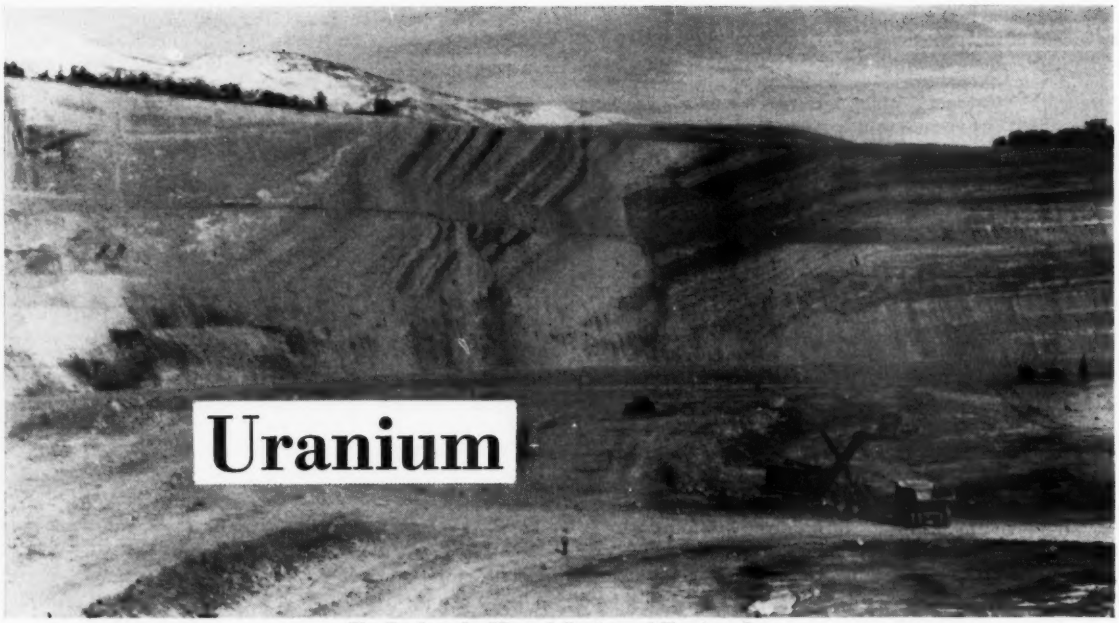
This warning should alert Congress to its responsibility in carrying out a complete and unbiased investigation into the controversial gold question. Only by this search and the finding of facts can the confusion be cleared up. Congress, it is up to you.

COMPARISON OF GOLD STATISTICS

Values—$35 per fine ounce

		Year	U. S. Production	U. S. Mint Sales to Industry, Arts and Professions	Private Smelter Sales to Ind., Arts & Professions Under Treas. Dept. Lic.	Total Sales to Ind., Arts & Professions
Pre-War Period		1934	$108,191,400	$775,155	None	$775,155
		1935	126,324,900	383,347	None	383,347
		1936	152,508,800	722,857	None	722,857
		1937	168,158,900	514,248	None	514,248
		1938	178,143,400	244,004	None	244,004
		1939	196,391,000	316,365	None	316,365
			929,718,400	2,955,976		2,955,976
World War II Period		1940	210,108,700	241,057	$3,763,785	4,004,842
		1941	209,174,600	1,104,500	7,956,415	9,060,915
	U. S. War & L-208 Pd.	1942	130,963,210	7,996,775	11,711,735	19,708,510
		1943	48,808,270	17,502,973	23,507,820	41,010,793
		1944	35,778,330	41,589,833	23,694,090	65,283,923
		1945	32,511,255	82,763,912	19,688,760	102,452,672
			667,344,365	151,199,050	90,322,605	241,521,655
Post-War Period		1946	51,182,390	123,253,662	13,880,195	137,133,857
		1947	75,786,130	44,851,003	24,998,190	69,849,193
		1948	70,891,800	38,000,289	24,739,120	62,739,409
		1949	67,268,215	78,727,710	21,963,165	100,690,875
		1950	80,104,780	80,383,098	25,691,610	106,074,708
		1951	66,315,410	67,539,694	21,172,515	88,712,209
		1952	67,445,000	68,413,021	18,424,804	86,837,825
		1953	68,950,000	55,026,722	18,904,537	73,931,259
		1954	65,065,000	29,310,442	15,003,038	44,313,480
			613,008,725	585,505,641	184,777,174	770,282,815
			$2,210,071,490	$739,660,667	$275,099,779	$1,014,760,446

Source: U. S. Department of the Treasury—Bureau of the Mint.
All figures on calendar year basis.



Uranium

The Rattlesnake Mine of Continental Uranium Co.

The uranium industry surged ahead at an unprecedented rate during 1956. Mine production reached a new high, and reserves were extended materially. Plant capacity doubled during the year and substantial new capacity is being constructed or is under contract. The Atomic Energy Commission released recently declassified information on domestic uranium production and ore reserves. Price guarantees extending until 1966 are the basis for long-range development and planning in the uranium industry, but the ultimate future will depend upon uranium's role as a fuel for nuclear power.

By JACK KRATCHMAN
Division of Raw Materials
United States Atomic Energy Commission

MORE ore reserves were developed in 1956 than in any preceding year of the domestic uranium program. In spite of depletions by continually increasing mine production rates, reserves are now estimated at approximately 60 million tons of measured, indicated, and inferred ore averaging 0.25 percent U_3O_8.

The reserves listed in Table 1 are confined mainly to sedimentary formations in the Colorado Plateau and in Wyoming. Many formations in these areas contain small deposits but the greatest percentage of reserves, at the present time, is in the Morrison, Chinle, and Wasatch formations.

The increase in total reserves has been accompanied by a change in the type of ore deposits discovered. When total reserves were small, the mines contributing to the reserves were numerous and ranged in size from 1,000 to 10,000 tons, with few containing as much as 100,000 tons. Today there are 41 mines with a reserve between 100,000 and 500,000 tons, and several with even greater reserves. As a result, the bulk of our reserves is now concentrated in relatively few districts. Noteworthy among these are Ambrosia Lake and Laguna, N. M., and Big Indian Wash, Utah, which contain over 70 percent of the total reserves. Substantial reserves are also located in the Wyoming Basins; Monument Valley, Ariz.; and in White Canyon, Utah.

TABLE 1—Estimated Ore Reserves

Area	Tons (in millions)	U_3O_8 (percent)
New Mexico	41.0	.24
Utah	7.5	.34
Colorado	4.1	.33
Arizona	2.6	.30
Wyoming	2.3	.22
Washington	1.5	.18
Others	1.0	.24
Total	60.0	Average .25

All of these areas were discovered prior to 1956. The dominant theme this year was exploratory drilling, physical development of previously discovered areas, and extension of known ore bodies.

Notwithstanding this trend towards consolidation of earlier discoveries, exploration continued in outlying areas. Some of the more interesting areas are in the Pryor Mountains of Montana and the Big Horn Mountains in Wyoming; and Saguache County, Colo.

Uranium in the Pryor Mountains occurs as cave fillings and coatings on the walls of caves in the Madison limestone, or as fracture coatings and cavity fillings within silicified breccia zones.

Interesting uranium occurrences in Saguache County, Colo., are being explored in the Harding quartzite, Fremont and Leadville limestones, and

TABLE 2—Domestic Mills Operating in 1956

Name	Location	Capacity Tons Ore/Day
The Anaconda Company	*Bluewater, N. M.	3,000
Atomic Energy Commission	Monticello, Utah	600
Climax Uranium Co.	Grand Junction, Colo.	350
Kerr McGee Oil Industries, Inc.	Shiprock, N. M.	500
Mines Development, Inc.	*Edgemont, S. D.	300
Rare Metals Corp.	*Tuba City, Ariz.	250
Union Carbide Nuclear Co.	*Uravan, Colo.	850
Union Carbide Nuclear Co.	Rifle, Colo.	280
Uranium Reduction Co.	*Moab, Utah	1,500
Vanadium Corp. of America	Durango, Colo.	430
Vanadium Corp. of America	Naturita, Colo.	350
Vitro Uranium Co.	Salt Lake City, Utah	550
	Total	8,960

* Initial or increased production in 1956.

along the contacts of Tertiary volcanic flows and Precambrian granites.

Preliminary reconnaissance is also evaluating selected sites in Oklahoma, Missouri, Arkansas, Michigan, North Carolina, and New York.

The Government's exploration program has been modified considerably as a result of the improved supply and production picture. Basic studies will be emphasized to gain a better insight into the various problems of uranium geology. At the same time, evaluation of ore reserve potentials and private exploration activity will continue in order to provide information required for planning purposes in the Commission's procurement program.

The trend is towards large capacity mills which treat ores from larger ore bodies. Integrated operations have become common and a pattern comparable to other non-ferrous metal production has begun to appear in the uranium industry.

Simultaneously, with the release of production and reserve figures, the Commission also declassified information on mill capacities. At the end of 1956, 12 uranium mills were operating in the United States; their locations, operators and capacities are listed in Table 2.

Contracts have been negotiated for the purchase of concentrates from the following mills:

TABLE 3—New Mill Capacity to be Completed in 1957 or the First Half of 1958

Name	Location	Rated Capacity Tons Ore/Day
Atomic Fuels Extraction Co.	Bedrock, Colo.	200
Dawn Mining Co.	Ford, Wash.	400
Gunnison Mining Co.	Gunnison, Colo.	200
Lost Creek Oil & Uranium Co.	Split Rock, Wyo.	400
Lucky Mc Uranium Corp.	Fremont County, Wyo.	750
Trace Elements Corp.	Maybell, Colo.	300
Texas Zinc Minerals Co.	Mexican Hat, Utah	775
Union Carbide Nuclear Co.	Rifle, Colo.	*1,000
	Total	4,025

* Including ore fed to concentrating plants. Will replace Union Carbide Nuclear Company's Rifle mill listed in Table 2.

Integrate Milling and Mining

Concurrent with the large increase in ore reserves, mining operations have produced ore at record rates. In the last half of 1955, 840,000 tons of ore were produced. Production in the first half of 1956 jumped almost 60 percent, to 1,340,000 tons, and to an estimated 1,660,000 tons in the last half of 1956. This brings the annual production in 1956 to approximately 3,000,000 tons—many times the 1948 production rate. The 1956 mine-production rate is expected to be doubled within three years, making the United States the foremost producer of uranium in the Free World.

With the discovery and development of larger ore bodies has come a rapid build-up in ore-processing facilities.

Integrated mining and milling operations related to the larger ore bodies are attractive to major companies capable of providing adequate financing and technical skills. Consequently, a number of mergers and purchases have taken place.

When the mills listed in Table 3 are completed, investment in domestic uranium mills will total approximately $85,000,000. Other proposals for constructing milling facilities are being negotiated.

Uranium concentrate production from expanded mill capacity increased substantially. Production of 3,400 tons of concentrate in the last half of 1956 was more than double that of the comparable period in 1955. The total for 1956 was approximately 6,000 tons.

JACK KRATCHMAN, who was trained in geology at New York University and the College of the City of New York, has been associated with the Atomic Energy Commission since 1951. During that time he has been engaged in geological studies in Utah, Nevada and overseas. Currently he is serving on the staff of the Assistant Director for Exploration of the Division of Raw Materials, and is responsible for uranium evaluations in the eastern United States.

By-product uranium production from phosphate plants continued at Joliet, Ill., and Bartow, Fla. New production in 1957 will be obtained at East Tampa, Fla., from the U. S. Phosphoric Products Co., Division of Tennessee Corp. Solvent extraction of uranium from phosphoric acid is used in the process.

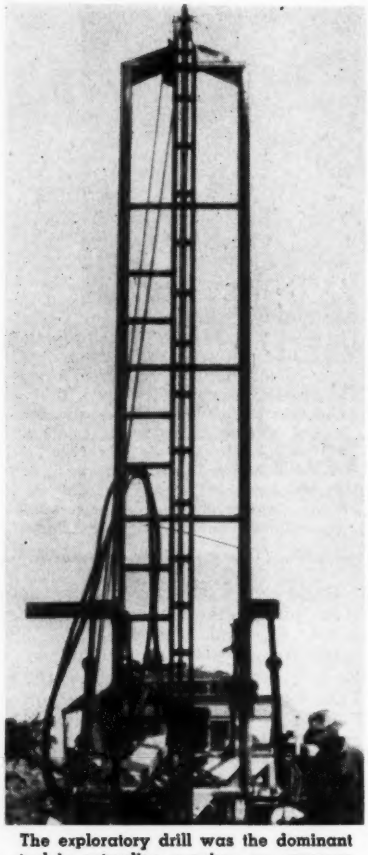
Metallurgical Developments

At the present time, mills separate dissolved uranium from leach liquors by chemical precipitation, ion exchange or solvent extraction. The ion-exchange process accounts for most of the world's concentrate production.

Because domestic ores frequently contain abundant clays which hamper filtration, a variation on the ion exchange process is used in many mills in the western United States. This variation, known as the resin-in-pulp process, permits the use of IX resins to extract uranium from pregnant pulps thus avoiding difficult filtration or clarification.

Continuing process development research by the Commission has taken place on the extraction of uranium from leach liquors by the use of solvent extraction. This process developed for the Commission by the Dow Chemical Company and piloted at Salt Lake City by the Bureau of Mines has been put into full scale production at such plants as Kerr McGee at Shiprock, N. M., and Climax at Grand Junction, Colo. Vitro is designing a solvent extraction unit at its Salt Lake City plant and others are considering incorporating this new technique into their flow sheet.

Other process development research on behalf of the Commission, continued at Winchester, Mass., by the National Lead Co.; Salt Lake City, Utah, by the Bureau of Mines; Columbia University; University of Nevada;



The exploratory drill was the dominant tool in extending uranium ore reserves in 1956

and the Dow Chemical Co., at Pittsburg, Calif.

Until recently all domestic concentrates were purified or refined in Commission owned refineries. About a year ago industry was invited to submit proposals to the Commission for the refining of 5,000 tons per year of U_3O_8 concentrate. All the Commission's technology was made available to the companies who expressed interest in the program.

As a result, the Commission received proposals from seven companies to build and operate a refinery. The proposal submitted by the General Chemical Co., Division of the Allied Chemical and Dye Corp., was accepted by the Commission.

Government Programs

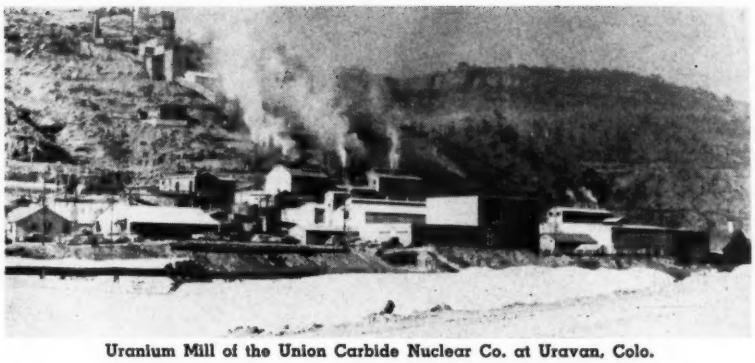
Changes in Government policy and procedure during 1956 which affected domestic uranium exploration included the following:

1. A new domestic uranium procurement program beginning April 1, 1962, and ending December 31, 1966, was announced by the Commission. During this period a guaranteed market will be provided for all domestically produced uranium concentrates meeting specifications, subject to a limitation, at the Commission's option, of 500 tons of U_3O_8 per year from any one mining property or mining operation. Uranium contained in normal mill concentrates will be purchased at $8 per pound of U_3O_8. No vanadium will be purchased under this program. It is hoped that these extended guarantees will help maintain effective exploration and development.
2. Payment of the initial production bonus for uranium ore was extended to March 31, 1960. Extension of this bonus will be helpful to new discoveries during early stages of development and mining.
3. Circular 5 (Revised) was changed to allow payment of development allowances to mine operators, shipping in excess of 1,000 tons of ore per year, without requiring proof that the development allowance has been spent to develop or explore their properties.
4. Because airborne activities by the Commission have been reduced to the use of four airplanes as an adjunct to its general geologic studies, the aerial prospecting program was terminated.
5. Competitive bidding to lease uranium deposits controlled by the Commission on withdrawn public lands has been instituted. Because of the improved supply picture it is not expected that many deposits will be offered for lease. Details of the new leasing method are contained in the Federal Register dated July 16, 1956.
6. Exploratory drilling by the U. S. Geological Survey and the Commission was terminated and a request was made by the Commission for restoration of approximately 260 sq mi of previously withdrawn land. Only approximately 50 sq mi, which have been leased or are suitable for leasing, have been retained by the Commission. It is estimated that drilling in excess of 8,000,000 ft was performed by private industry during 1956. This is considerably higher than the rate of drilling for 1955.
7. Lucius Pitkin, Inc., replaced American Smelting and Refining Company as the Commission's agent for uranium-ore buying and concentrate receiving in the western United States. The Pitkin firm will maintain ore-buying stations at Marysvale, Moab, and White Canyon, Utah; Globe, Ariz.; Riverton, Wyo.; and Grants, N. M. In addition, it will operate the concentrate sampling plant and assay laboratory at Grand Junction, Colo.
8. The contract for the operation of the government-owned uranium processing mill at Monticello, Utah, was awarded to the National Lead Co. The Galigher Co., the prime contractor, did not wish to extend its contract. This mill is the only one owned by the government.
9. A new lime penalty schedule has been established for the Commission ore-buying stations at Moab and Monticello, Utah. Under this revised schedule shippers have the option of selecting the standard lime penalty with payment for the contained vanadium or they may refuse payment for vanadium and avoid the lime penalty.

Open cut methods using modern earth-moving equipment were employed at some of the larger operations

Foreign Developments

The Commission has an interest in uranium exploration and development in foreign areas as a means of providing assistance to the western world in accordance with President Eisenhower's Atoms-for-Peace Program. In connection with the latter program



Uranium Mill of the Union Carbide Nuclear Co. at Uravan, Colo.

the AEC has announced a program to assist friendly nations in uranium exploration. The objective of this program is to help these nations in the development of their own uranium resources for civilian nuclear-energy applications.

It is contemplated that support of these foreign exploration programs will include some or all of the following:

1. Dissemination of information through technical reports covering various aspects of uranium exploration methods and techniques.
2. Visits to the United States by foreign geologists and engineers will be arranged in order to acquaint foreign technicians with the various types of uranium deposits in the United States and with applied exploration techniques, milling procedures, and laboratory methods. The first tour under this part of the program took place in September and included 31 geologists and engineers from 18 nations.
3. Direct technical assistance may be made in the form of brief visits by Commission geologists to foreign nations. These visits would involve discussions of uranium exploration problems and preliminary reconnaissance of favorable locations or areas.

Uranium in Canada

Except for that required for its own program, virtually all uranium production from Canada has been sent to the United States according to contractual arrangements between the U. S. Atomic Energy Commission and Eldorado Mining and Refining, Ltd. The Canadian Government extended its deadline for initial production from companies holding special price contracts to September 30, 1957. Submission of applications for special price contracts was required before March 31, 1956.

In anticipation of the expiration of the deadline for special price contracts, exploration for new deposits practically ceased in Canada during 1956. Instead, effort has been directed to development work and bringing mines into operation in previously discovered areas such as the Beaverlodge district, northwestern Saskatchewan; Blind River district, south-central Ontario; and the Bancroft area in southeastern Ontario about 150 miles east of Toronto. Minor production from a 150-ton mill is planned from the Marion River area located near Great Slave Lake, in the Northwest Territory.

The most noteworthy developments have taken place at the major uranium field at Blind River, where extensive deposits of uranium-bearing, Precambrian quartz pebble conglomerates outcrop in a reverse S-shaped pattern for many miles. Three mineralized zones have been established with remarkably uniform ore grade. Deposits are similar to those of the Witwatersrand, except that gold is not present in important amounts.

Sufficient reserves have been indicated to assure Blind River's place as a major uranium source for decades to come. Contracts for the sale of uranium concentrate have been executed in excess of one billion dollars. In order to meet these contracts over a quarter of a billion dollars is being spent in development, construction, and supporting services. When construction is complete, there will be 11 mills capable of a daily capacity of more than 30,000 tons of ore.

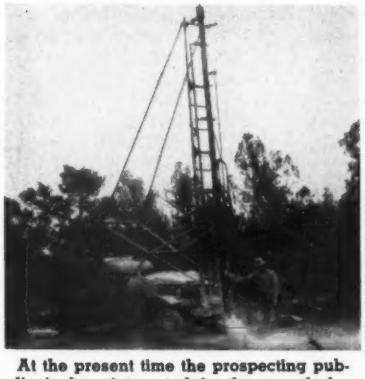
Numerous mines are contributing to the production picture at Beaverlodge. The Eldorado mill is being increased to a capacity of 2,000 tons per day and the Gunnar mill is being expanded to a daily capacity of 1,650 tons. Preparations are being made to supplement open pit operations by underground mining at the Gunnar property. The Lorado mill is planned to be completed in mid-1957, and will treat custom ores as well as its own.

The Bancroft area is unique among major uranium producers in that the ore consists of pegmatite-like dikes containing uranium ore lenses 5 to 12 ft in width and extending several hundred ft in length. The Bicroft mine is the first property in production with a 1,000-ton capacity mill. It is anticipated that production in early 1957 from a 750-ton capacity mill at the Faraday property will add to production from the Bancroft camp. Dyno Mines, Ltd., plans to construct the third mill, of 1,000 tons per day capacity, provided adequate financing can be obtained.

The trend to increased mechanization in uranium mining throughout the world is exemplified by mining practice in the Blind River district. The Consolidated Denison mine, for example, plans to use a "room and pillar" system similar to that used in coal mines. Five entries driven in ore along an 18° slope will connect two shafts. For the first time in uranium mining, conveyors will be used to transport broken ore to the shaft. Ore will be removed in panels at right angles to the inclined entries, using trackless equipment and belt conveyors.

South Africa

Uranium from South Africa is obtained as a by-product of the treatment of gold ores from the Witwatersrand conglomerates.



At the present time the prospecting public is less interested in the search for ores of the common metals than for uranium

Seventeen plants have been authorized to produce uranium concentrates from gold tailings in the Transvaal and Orange Free State. With the two new processing plants at West Driefontein and Hartebeestfontein, a total of 16 plants are now complete, and virtually all authorized production capacity is now in operation.

Because it is possible to apply extraction and treatment costs to two products, gold and uranium, economic reserves of both materials are increased substantially. Reserves are considered ample for many years of production from this source.

Australia

In Australia, uranium exploration and development were centered in the Northern Territory, the Mount Isa-Cloncurry region of western Queensland, and Radium Hill, South Australia.

The most important activity is located at the Mary Kathleen mine near Mount Isa in western Queensland. This unusual deposit contains uraninite and allanite replacing a brecciated skarn host rock close to a granite intrusion.

A subsidiary of the Rio Tinto Company, Ltd., of London, is developing this property and plans to mine the large ore-body by open-cut methods. It is anticipated that initial production of concentrate will begin in 1959, and the United Kingdom will receive uranium concentrates valued at over £40 million during the life of the contract. Rio Tinto by its control of this property and much of the Blind River camp in Ontario, Canada, has established itself as the largest potential producer in the uranium mining industry.

At Rum Jungle, Northern Territory, production from open-pit operations continued. Minor production also was obtained from Adelaide River and Brock's Creek. Milling difficulties at Rum Jungle were overcome and production rates reached the levels called for in original designs.

A relatively small production of high grade ore, assaying over 50 percent U_3O_8 was shipped from the El Sharana lease, Northern Territory. Low-grade mechanical concentrates from mining operations at Radium Hill, South Australia, were treated on a routine basis at the chemical treatment plant located at Port Pirie. Legislation has now been passed which will permit private industry to develop uranium properties in South Australia.

France

Exploration and production continued in France as well as some of her overseas possessions. Pitchblende vein-type deposits in granites of Hercynian age are being developed at La-Crouzille near Limoges; Vendee in Brittany; Lachaux in the vicinity of Vichy; and Grury in the department of Saone and Loire. Reconnaissance is also taking place in the Sahara, French West and Equatorial Africa, and French Guiana, but no exploitable deposits have been reported in these areas to the present time.

At the end of 1956 France revealed details on her uranium reserves and production. The French estimate reserves of 50 to 100,000 tons of contained uranium for metropolitan France. Lesser amounts are estimated for Madagascar where uranium is found associated with thorianite.

A mill at Gueugnon in the department of Saone and Loire is reported to have an annual ore capacity of 50,000 tons. Mills are currently being constructed at Ecarpière in the department of Vendee (annual ore capacity of 300,000 tons) and at Bessines in the department of Haute Vienne (annual ore capacity of 200,000 tons). In 1957 chemical concentrates produced from these facilities will contain 380 tons of uranium. By 1975 the French anticipate a production of 3,000 tons of uranium annually.

Portugal and Belgian Congo

Operations in Portgual from veins similar to the French deposits, continued at a normal rate during 1956. Production from the Shinkolobwe mine continued to be an important source of uranium.

Outlook

During 1957 important new mines, mills, and refinery facilities are scheduled to begin operation. In the United States it is anticipated that mills at Ford, Wash.; Mexican Hat, Utah; and Split Rock, Wyo., will be operating in 1957.

Completion of the presently authorized processing capacity to a total of 17 plants in South Africa is planned for next year.

Major construction to be completed in Canada include the mills at the following properties: Algom-Nordic, Can-Met, Faraday, Consolidated Denison, Lorado, Rayrock, Panel, Spanish American, Lake Nordic and Stanleigh.

Uranium price guarantees extending until 1966, now afford an incentive and a basis for long-range planning. Military requirements will remain the chief support of the uranium market during this period. Ultimately, there is no doubt that the future of the uranium mining and milling industry depends on uranium's use as a fuel for nuclear power.

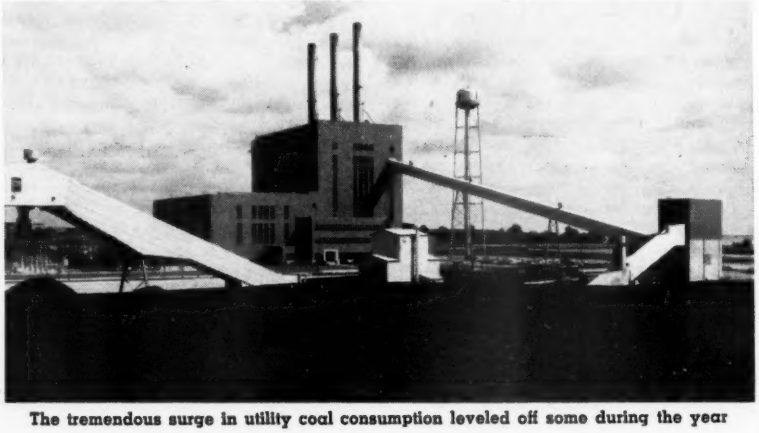
The demand for uranium for peacetime applications will depend on the number and types of reactors which will be installed. Many forecasts have been made but precise estimates on demands and the markets depend upon future developments.

Bituminous Coal

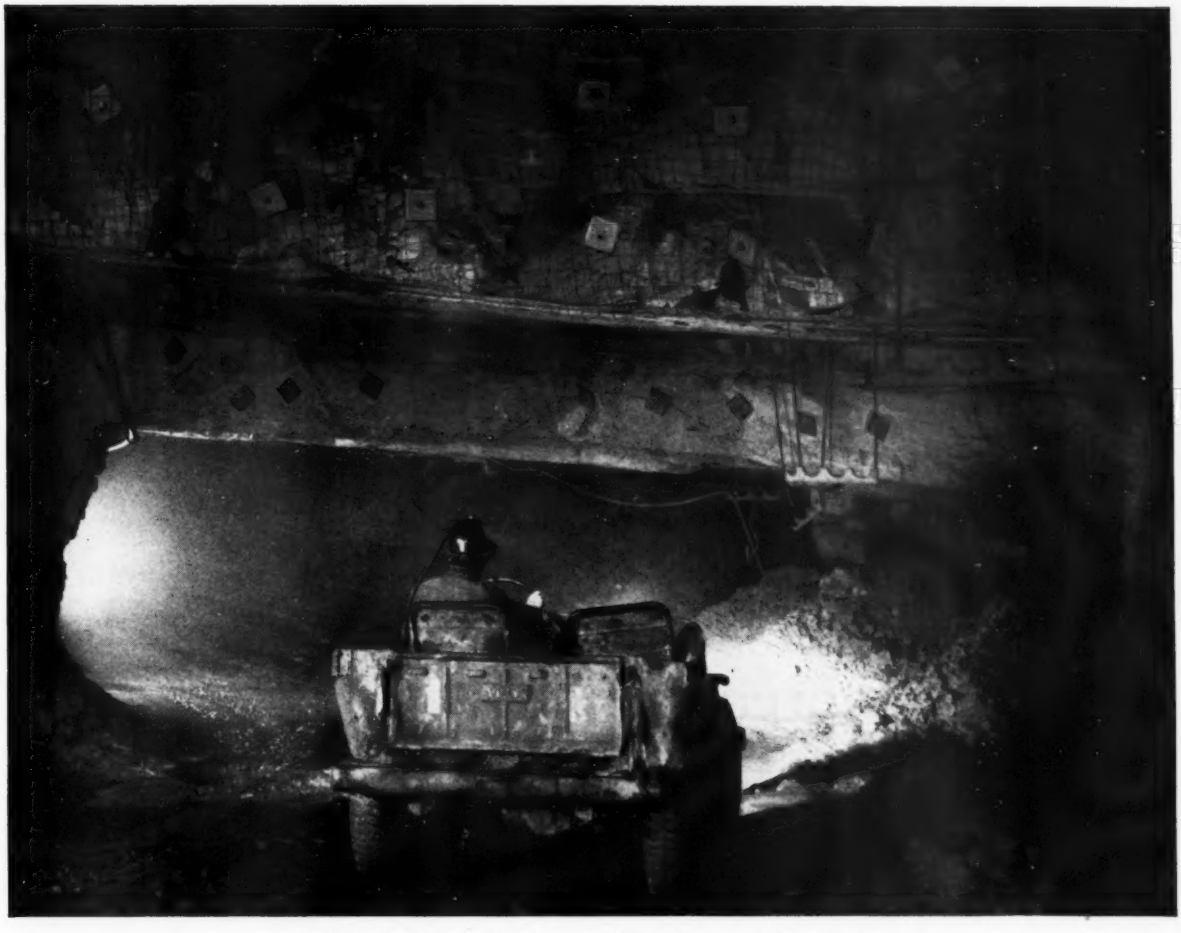
(Continued from page 54)

is being located to use coal-generated power. This is causing a marked change in the geography of the aluminum production. Aluminum operations first were attracted to areas having cheap hydro power, even though distantly removed from markets. Hydro power became scarce after World War II and producers located additional capacity near the major natural gas fields to have a cheap fuel available for power generation. Gas rates advanced, however, leaving coal as the attractive fuel for power output. Three new aluminum plants are being built in the Ohio Valley which, besides having an abundance of coal and extensive water transportation facilities, is within easy reach of the major aluminum markets.

Aluminum and other industrial movements to the Ohio Valley not only demonstrates coal's growing importance as an energy source but also gives coal a potential for developing new market outlets. A coal processing plant is being constructed at Cresap, W. Va., by Pittsburgh Consolidation to produce a boiler-fuel char which will be burned to generate power for the nearby Olin Mathieson aluminum plant. In making the char this processing plant will extract liquids which will be used as raw materials for chemical output. At the same location, a carbon calcining plant is being built by Mountaineer Carbon, a company jointly owned by Pittsburgh Consolidation and Standard Oil of Ohio. Calcined carbon is used mainly as electrode carbon material in the aluminum, electro-metallurgical and chemical industries. Part of the raw material for this plant will be petroleum supplied by Sohio and part will be coke supplied by Pittsburgh Consolidation. These are examples only of market development, but they may be forerunners of a coal utilization much broader than is presently recognized.



The tremendous surge in utility coal consumption leveled off some during the year



Bethlehem Roof Bolts, used with square plates and wire mesh, in metal mine.

You get increased safety with Roof Bolting

Mines become safer, with the danger of severe roof falls unlikely, when you install Bethlehem headed roof bolts. This is because the bolts anchor overlying strata into a thick, secure beam.

Bethlehem roof bolts have other advantages, too. Their use makes possible wider openings and clearances . . . full use of mechanized equipment at the face . . . good ventilation, due to the absence of bulky supports . . . and no fire hazard.

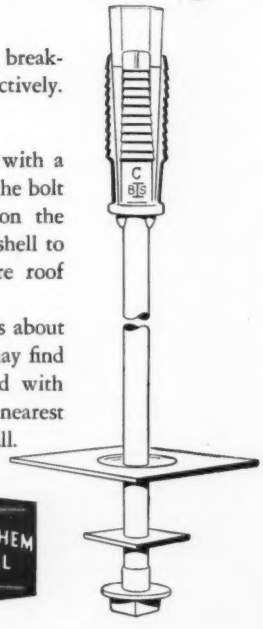
Four Types of Headed Bolt

The Bethlehem square-head roof bolt is manufactured in four types: a ¾-in. carbon-steel bolt and a ⅝-in. high-strength bolt, each of which has a typical breaking load of 24,000 lb; a ¾-in. and a ⅞-in. high-strength bolt, having typical breaking loads of 34,000 lb and 45,000 lb, respectively.

How Bolt Is Used

The Bethlehem headed roof bolt is used with a malleable-iron shell and steel plug. When the bolt is tightened, the plug is drawn down on the threads, expanding the four leaves of the shell to provide positive locking action. A square roof plate provides additional support.

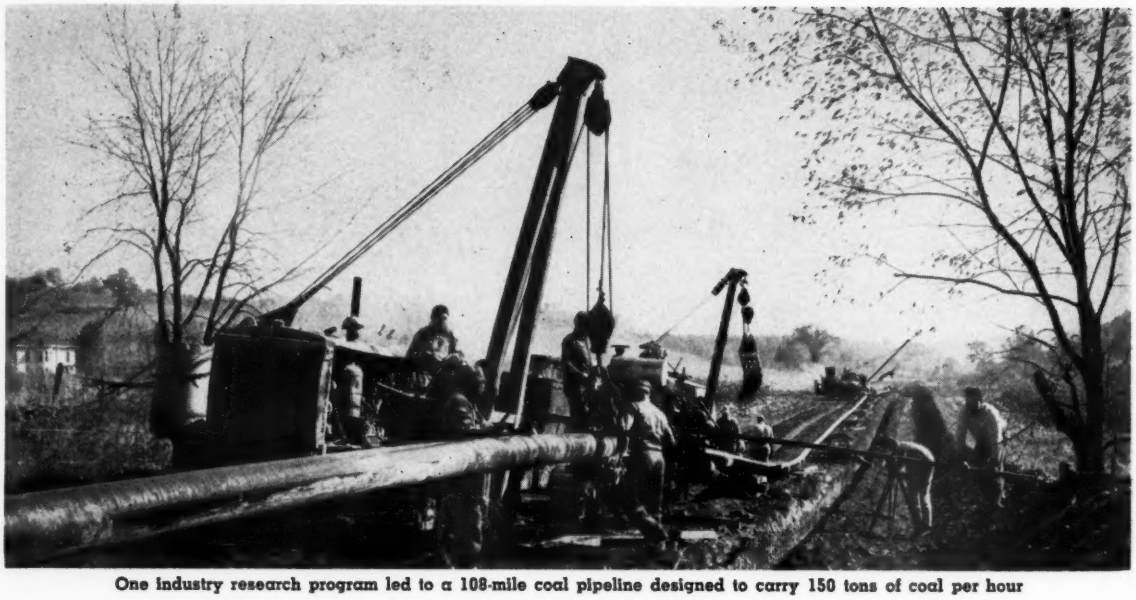
We'll be glad to answer your questions about using the square-head roof bolt. Or you may find our 1-in. slotted roof bolt, which is used with a steel wedge, more to your liking. The nearest Bethlehem sales office is awaiting your call.



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



One industry research program led to a 108-mile coal pipeline designed to carry 150 tons of coal per hour

Coal Research in '56

Industry spent approximately $17,500,000 during year on research programs

By J. W. IGOE and H. J. ROSE
Respectively, Assistant Director—Administration; and Vice-President and Director of Research Bituminous Coal Research, Inc.

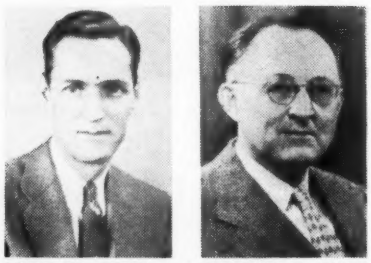
BITUMINOUS COAL RESEARCH, INC., the national research association for bituminous coal, surveyed all coal research activities known to it to discover as completely as possible the nature of coal research activities during 1956. As is common in such surveys, a few organizations conducting research projects on coal or its utilization did not make information available for business reasons. This article summarizes the projects reported for the United States and Canada, with some general comments on research abroad.

For those interested in complementary information about the status of coal research activities in the United States and research possibilities, the authors recommend a study of U. S. Bureau of Mines Information Circular 7754, entitled "Outlook and Research Possibilities for Bituminous Coal." This publication produced by the U. S. Bureau of Mines and Bituminous Coal Research, Inc., at the request of Felix E. Wormser, Assistant Secretary — Mineral Resources, United States Department of the Interior, early in 1956 surveyed the status of research on bituminous coal and included lists of research projects which would be of value to the coal industry. Where applicable, those lists were related to specific coal markets. This publication reviews the economic position of the coal industry and discusses the competitive forces responsible for coal's position. Table 1 of that report shows an estimated $17,382,400 spent during 1955. This is the latest and most authoritative study of coal research in the United States. The rate of effort in 1956 will not be significantly different from that of 1955.

Table 3 of the same report shows the sources of funds for coal research during 1955. Several companies did not supply information for this study.

Information Circular 7754 cites the National Science Foundation for a comparison of coal research activities with research expenditures during 1953 as follows: petroleum industry—$145,900,000; textile industries—$28,000,000; rubber products, $53,600,000, and the chemical industry —$36,100,000!

Information Circular 7754 does not identify individual companies and projects with expenditures because such a procedure would divulge confidential information. This article covers a later survey by BCR, and identifies specific projects and sponsors, but without the sponsors' expenditures. The material is presented in broad subject classifications: properties of coal, production and preparation, utilization as a fuel, and conversion to another form prior to end use.



JOHN W. IGOE and HAROLD J. ROSE are no strangers to readers of Mining Congress Journal. They have collaborated several times in the past to bring the story on bituminous coal research up-to-date.

Dr. Rose is vice-president and director of research for Bituminous Coal Research, Inc. He has authored several papers on solid fuels investigations here and abroad and also holds the Grasselli gold medal of the Society of the Chemical Industry.

John Igoe, BCR assistant director-administration, has had a broad background in technical writing and much experience in market development.

Summary Data on Coal Research, 1955

	Expenditures		Professional Manpower	
	Dollars	Percent	Number	Percent
Coal resources	1,478,600	8.5	187	19.8
Mining	3,038,700	17.5	140	14.8
Preparation	606,400	3.4	45	4.8
Storage and transportation	97,900	0.6	5	0.5
Combustion	1,121,800	6.4	42	4.5
Coke and coal chemicals	5,435,400	31.3	273	28.9
Gasification of coal	2,517,900	14.5	91	9.7
Coal hydrogenation	2,080,100	12.0	93	9.8
Physical and chemical properties	1,005,600	5.8	68	7.2
Total	17,382,400	100.0	944	100.0

(Source: U. S. Bureau of Mines I. C. 7754)

Sources of Funds for Bituminous-Coal Research [1]

Federal	$ 4,863,737
State	579,727
Commercial coal	2,452,284
Captive coal	1,206,888
Equipment manufacturers	3,220,810
Other industrial	4,954,954
University and unidentified funds	104,000
Total	$17,382,400

[1] When companies were known to be engaged in several functions (for example, a company that makes equipment, processes coal, and sells coal) and where several projects were reported by such a company, an attempt was made to distribute the amounts to the appropriate lines in the table.

Coal Properties

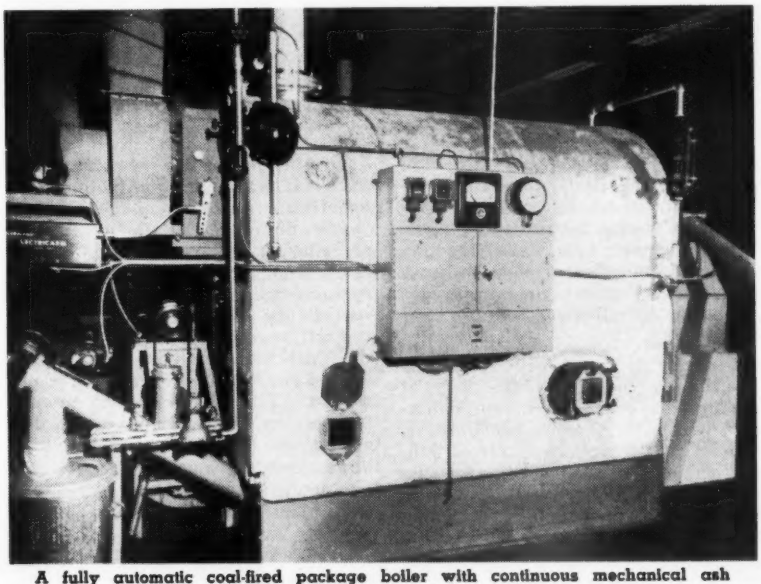
Constitution and Petrography—During 1956 the Alabama State Mine Experiment Station, at the University of Alabama, published a compilation of complete analyses of Alabama coals published since 1925 in the Warrior and Plateau fields and the results of a study on the petrographic composition of two Alabama whole coals compared to the composition of their size and density fractions. The Experiment Station also continued its project of analyzing and testing the physical properties of Alabama coals. The Illinois State Geological Survey conducted fundamental research on coal plasticity to gain a better understanding of why coals show plastic properties. The Geological Survey reports that data obtained thus far are not adequate for conclusions to be made. A survey of recent literature on coal oxidation is expected to be published early in 1957. A total of six projects relating to fundamental studies of coal in the fields of coal petrography and paleobotany by the Illinois group include studies of coal reflectance, petrographic analyses, and special studies of coal spores and coal balls. They also carried on research relating to strata associated with Illinois coal beds.

Pennsylvania State University reports that it has conducted research on the pyrolysis of humic acids and sodium humates prepared from nitric acid treatment of bituminous coal in a temperature range from 200 to 900° C. Examination of the chars reveals that a gradual elimination of the hydroxyl, nitro, carbonyl, and carboxyl groups takes place with increase in temperature. The most pronounced change appears at about 500° C. These changes are further characterized by a gradual decrease in solubility of the chars with increase in temperature. Other projects at Penn State include mass spectroscopy of pyrolytic products of bituminous coal, the fusibility of coal ashes, and gas diffusion in anthracite. The objective of the gas diffusion study is to aid in the interpretation of the physical structure of anthracite.

The U. S. Bureau of Mines is studying the relationship of the petrographic analysis of coal determined by microscopical methods to the preparation, carbonization, and hydrogenation properties of the coal. In cooperation with other research organizations, including the Illinois Geological Survey and ASTM, the Bureau is aiding in the development of national and international standardization of methods of coal and coke sampling, analysis, and testing, and in the formulation of an international system of coal and coke classification. The thermal treatment of coal and other carbonaceous materials derived from and related to coal is being studied to determine structural changes and rates of these changes during the treatment period. The petrographic components of coal are being studied intently by determining their composition and fundamental physical properties.

Information on the physical structure and properties of lignite is being developed by the Bureau by fractionation and analytical studies of low-temperature tars from lignites. Studies are under way to separate and characterize the tar components and to determine methods of treatment to obtain more valuable products from the tars.

Virginia Polytechnic Institute conducted fundamental research on the ultimate strength of coal, on the possible occurrence of elemental sulphur in the Merrimac coal bed, and a laboratory investigation on a possible means of formation of extensible



A fully automatic coal-fired package boiler with continuous mechanical ash removal has been designed

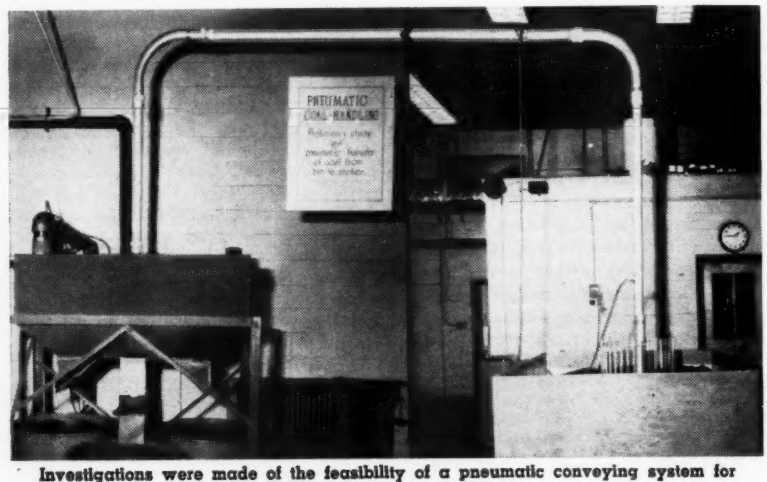
coal beds as associated to strand line sedimentation.

The Nova Scotia Research Foundation began work on the spectroscopic content of minor metallic elements of Nova Scotia coals. In a physical chemistry project the Foundation is attempting to find answers to problems regarding the basic composition of coal and its chemical and physical reactions under certain conditions, particularly those factors involved in the mild oxidation of coal with pure oxygen. Nova Scotia Technical College conducted a fundamental petrology study and the Canadian Department of Mines carried out fundamental research on physical and chemical characteristics of Canadian coals.

Production and Preparation

Reserves—The Ohio Division of Geological Survey and the Illinois State Geological Survey carried out studies of coal resources in their respective states.

The U. S. Bureau of Mines published its final reports on known recoverable reserves of coking coal for



Investigations were made of the feasibility of a pneumatic conveying system for handling coal in small plants

counties in the Appalachian coal region. In the study, recoverable reserve estimates have been made for a total of 44 counties in Pennsylvania, West Virginia, Maryland, eastern Kentucky, and Tennessee. The work is continuing under the supervision of the U. S. Geological Survey.

Production—About one-fifth of all the money being spent on research relating to coal is in the field of mining and preparation. An important portion of these expenditures is being made by manufacturers of mining equipment. During the past several years there have been important additions to the mining equipment field and an increasing efficiency in coal mining due in part to the availability of more productive mining equipment. Coverage of the mining equipment portion of this field is presented more adequate elsewhere in this issue.

The Mining Development Committee of Bituminous Coal Research, Inc., included in its 1956 program research projects on extensible belts without idlers and requiring less manpower, development work on belt corner units, temporary roof supports, and cutter bits for mining machines. The Mining Development Committee investigated automation aspects of mining and preparation and the application of computers to increasing the productivity of coal mining. It undertook work on underground communications and on main line transportation by the use of trolley conveyors.

A project on the application of the Wilcox miner and the development of a suitable mining system for this equipment was completed by the North American Coal Corp.

Virginia Polytechnic Institute, West Virginia University, and the U. S. Bureau of Mines all continued research on roof supports during the past year.

The ten-year study of mine water initiated and originally operated under the sponsorship of the Sanitary Water Board of the Commonwealth of Pennsylvania and the coal industry is continuing at Mellon Institute. The coal industry later assumed the responsibility for the support of this project; sponsorship is now vested in the Coal Advisory Committee of the Ohio Valley Water Sanitation Commission. The Fellowship at present is applying information accumulated during the length of a project to a large complete watershed in a coal mining area which contains abandoned and operating deep and strip mines as well as loading tipples and washers. The Fellowship reports that complete solution of the drainage problem is not indicated for the immediate future, but reports encouraging progress. Another project relating to mine water is one by West Virginia University, which is investigating the corrosive effect of acid mine water.

A study was made by the U. S. Bureau of Mines of the recovery of coal by augering based upon operating data obtained at a selected group of auger mines. A Bureau report is in press outlining the method of operation and giving recovery and productivity data for the mines investigated.

Studies are under way to determine comparative costs using roof bolts and conventional timbering to support mine roof. The possible relationship between method of roof support and efficiency of mining equipment will be examined. Investigations are being made to develop a basis for selecting plans and equipment for face haulage that will be most suitable under given conditions.

In the field of anthracite mining research thick pillars under water-bearing sands, and strong, overlying rock strata manifesting severe squeeze conditions, indicated that definite advantages in safety, coal recovery, and efficiency could be realized by allowing the roof to subside gradually and evenly over a wide area. The Bureau published a report on the use of yielding steel supports props in combination with backfilling for mining thick flat beds.

Tests were conducted using a pneumatic, vibrating-blade coal planer, designed by Bureau personnel, in one of the hardest seams of anthracite, and results indicated rather conclusively the feasibility of this mining method. As a result the Bureau has decided to establish a longwall, coal planer project in the Northern Anthracite Field in cooperation with a large anthracite-producing company to study further the application of this type of equipment in anthracite mines.

West Virginia University Engineering Experiment Station conducted an investigation of gas emission at coal faces.

Work is being carried out on a cooperative basis to determine the causes of collapse of walls or roofs in coal mines in Canada. The Federal Department of Mines and Technical Surveys, the Nova Scotia Technical College, the Nova Scotia Department of Mines, and the Nova Scotia Research Foundation are cooperating in this work. In addition, the Nova Scotia Research Foundation has been conducting non-destructive testing of mining equipment. Work has been concentrated on testing of wire ropes used for haulage purposes. This work has resulted in the development of a portable electronic tester which can be carried underground easily. The

Canadian Department of Mines has investigated a mechanism of bumps and outbursts in coal mines.

Preparation—Because of the close connection between coal preparation and coal utilization, Bituminous Coal Research, Inc., during 1956, began an expansion of its research on coal preparation to complement current work on the development of improved coal utilization equipment and methods. As a result of this general objective, an exploratory investigation was conducted on the possibilities of drying coal in a low-cost, cascade-type dryer with encouraging results.

Heyl and Patterson, Inc. reports that its development work on a fluid bed dryer for fine coal has been completed and the unit is ready for market. This company also expanded its development work on its cyclone thickener. The University of Washington carried out an investigation on the role of viscosity in heavy media separation cleaning of coal, on flocculation and filtration characteristics of coal slurry, and the recovery of magnetite media from fine coal. They, as well as the U. S. Bureau of Mines and West Virginia University, conducted research on various aspects of coal cleaning.

The U. S. Bureau of Mines coal preparation studies include: testing of coal using dense-medium separators, kerosine flotation units, and a feldspar jig. Major attention has been directed toward the use of these devices for more efficient cleaning. Bureau studies have resulted in the kerosine flotation unit and the feldspar jig having cemmercial application. Other studies with the pilot-plant scale dense-medium equipment have revealed means for salvaging valuable coal from materials that had been waster heretofore. Fundamental studies of the physical characteristics of dense medium used to separate coal from its associated impurities have shown the relationship these characteristics bear to washing efficiency. An improved viscometer was developed to measure accurately the viscosity of magnetite suspensions. Reports were published giving the preparation characteristics of coals from counties in West Virginia, Kentucky, and Tennessee to supplement reserve estimates of coking coals. Coal preparation studies have been pubished on coals from 29 counties in this series of reports.

In the field of anthracite preparation, work was initiated on determining the washability characteristics of anthracite from the four producing fields.

Laboratory and field studies have been made to provide information on power requirements and equipment performance when crushing lignite. Attention has been given to the freezing of lignite and improved methods of measuring the degree of agglomerating have been developed. Using these improved methods of measurement, the comparative effects of additive compounds are being studied. Bench-schale tests to determine the carbonization characteristics of as-received and steam-dried lignites, under simulated process fuel-bed conditions, indicate that these materials may be used as lump fuel for pressure gasification with oxygen and steam. Based upon these determinations, a pilot-plant pressure gasifier is being erected to provide detailed information concerning capacity, process requirements, materials of construction, fuel preparation, and materials handling. Mechanical and control features under both slagging and dry-bottom operation will be studied. A study was made of the feasibility of hydraulic transportation of Texas lignite. Test data indicated that serious degradation occurred during transit and the resultant drying problems would probably preclude this method of transportation for lignite under the present all-rail freight rate schedule for lignite shipments.

Utilization As A Fuel

Despite the fact that 80 percent of all coal mined in the United States is used as a fuel, only 6.4 percent of the total research expenditures are being invested in projects relating to coal combustion. Important work in research on the use of coal as a fuel is being conducted, however.

The Babcock and Wilcox Co. continued its cyclone furnace development to improve combustion, reduce ash discharge to the stack, and extend the flexibility of this type of burning device to handle a greater variety of coals and low-volatile chars. Their ash handling work included investigations of coal ash corrosion, low-temperature corrosion, and improved cleaning methods. In the equipment field, B & W began the development of a jet ignition stoker and carried out ignitibility studies to grade coals according to ignition characteristics.

The Locomotive Development Committee of Bituminous Coal Research, Inc., reports that its 1956 program consisted of perfecting the performance of the Dunlab Ash Separator Tube; the development, improvement, and testing of their bulk aerated coal system; the redesign, construction, and testing of improved rotary coal pumps; and the redesign and rebuilding of the coal-fired gas turbine and subsequent proof testing.

The General Research Program of BCR conducts a major program of projects relating to the in-plant handling and use of coal as a fuel. Because the development of large industrial and electric utility coal-burning equipment is so well handled by equipment manufacturers, its coal utilization research has been concentrated on equipment and methods applicable to the commercial and small-to-medium industrial plants where coal is meeting some of its most severe competition from other fuels. Important advancements were made during 1956 to combat this competition.

During 1956 BCR, in cooperation with General Machine Co., converted a successful hopper feed anthracite-burning stoker boiler unit to a bin feed automatic ash removal stocker boiler using bituminous coal, for low-pressure heating installations for schools, churches, greenhouses, etc. These units, known as Fire-Jet burners, were in commercial production during 1956. The Pennsylvania State University also cooperated with the manufacturer in converting this unit to the use of bituminous coal.

Having proved that a coal-fired, package-type automatic steam generator was feasible, BCR continued its development of a low-cost automatic steam generator of the package type complete with stoker, boiler, controls, coal-handling equipment, and ash-handling equipment. Full-sized units with water-cooled and air-cooled grates were built and tested. As a result of this work, a low-cost timer control, a boiler design requiring considerably less head room, and stokers which are expected to handle a reasonably wide range of coals have been developed. Field trials of these automatic steam generators are planned for 1957.

Late in 1956, BCR initiated a techno-economic survey of small steam plants to give a better base for designing coal-burning equipment for the needs of coal users, to provide specific information on commercial and small industrial steam plants which would assist coal producers and their industry activities to promote the increased sale of coal, and to show potential manufacturers of coal-burning equipment that a substantial market for such equipment actually exists, and to provide them with information about the characteristics of such markets.

A major breakthrough in coal handling and bin design knowledge was made in recent months. The failure of wet, fine coal to flow from storage bins has long been a handicap for coal. In small plants this condition made automatic discharge of coal from bins virtually impossible without manual attention. In larger plants, excessive manpower may be required at times to maintain adequate flow of coal from storage bins to coal burners. BCR has developed a storage system for bulk solids in which it is possible to obtain reliable flow of coal from storage bins serving the full range of plant sizes, from greenhouses to electric utility plants. Such coal flow is possible under vari-

ous conditions of moisture content, bin loading, and discharge rates.

Because a pneumatic in-plant coal transport system permits establishing multiple pick up points with one prime mover at a lower cost than with mechanical conveyors, a laboratory investigation was conducted of the feasibility of a pneumatic conveying system for handling coal in small plants. The study covered power requirements, rates of flow, degradation, and dust loss problems. This work will continue during 1957.

Pittsburgh Consolidation Coal Co. during 1956 constructed the first commercial coal pipeline and announced that its operation will begin early in 1957. This pipeline is 108 miles long and is designed to carry 150 tons of coal per hour between Georgetown, Ohio, coal preparation facilities of Consol and the Eastlake Station of Cleveland Electric Illuminating Co.

In seeking to develop a method low in cost for capital investment and operation for eliminating heavy concentrations of solids from small industrial stacks during soot blowing, BCR found that water sprays could remove 60 to 70 percent of the solids in flue gases during soot blowing. Such a reduction would substantially overcome the nuisance occurring when soot blowers are used in the conventional small plant. Field test installations of the stack sprays were made late in 1956 and are under observation.

As a part of its program to develop a broad base of knowledge to permit the design of more efficient combustion units and in improving operating procedures through better control, BCR last year initiated a study of the factors affecting plastic and coking properties of coal. This work includes a study of the performance of standard reference coals in large-scale units and correlation of such data with bench-scale laboratory results. Currently work is being done in the development of a bench-scale furnace for a quick evaluation of the performance characteristics of coals.

Virginia Polytechnic Institute studied problems encountered in the combustion of coal and the effect on size consist of coal handled and its effect upon boiler performance. The Pennsylvania State University, in studying the relationship of ash fusibility in oxidizing and reducing atmospheres, found that oxidizing fusion temperature is always higher than the reducing temperature and the higher the iron content of the ashes, the greater is the temperature spread between the oxidizing and reducing figures.

To develop basic engineering relationships that would be applicable to the design of efficient combustion equipment, complex flow patterns and their concomitant energy interchanges were studied by the U. S. Bureau of Mines to improve heat-transfer and energy-loss characteristics of furnace combustion chambers, dust collectors, vortex gasifiers, tangential flow incinerators, and similar equipment.

The Bureau, in order to improve thermal efficiency of conventional coal-burning equipment and to devise new ways to burn coal in an effort to extend the flexibility of coal-burning equipment with respect to rank, grade, and ash characteristics of the fuel, made systematic studies to correlate furnace performance characteristics with size consist and shape of the fuel particles, air rates and their distribution, and preheating of primary air during ignition and burnout periods.

The role of ash, slag, and other deposits in the performance of furnaces was investigated. The U. S. Bureau of Mines developed a condensate-corrosion tester that indicated the rate at which condensate lines deteriorated under prevailing operating conditions. The tester established conditions under which chemical treatment would be advisable and measured the effectiveness of the chemical treatment after application.

In the investigation of combustion of fine coals and dusts in suspension, a suitable test furnace has been constructed by the Bureau. In addition to the combustion unit, auxiliary bins have been erected to study flow patterns of fine fluidized coal and char from storage facilities.

The Nova Scotia Research Foundation has conducted tests on operating and heating efficiency of automatic ash removal underfeed stokers using Canadian coals.

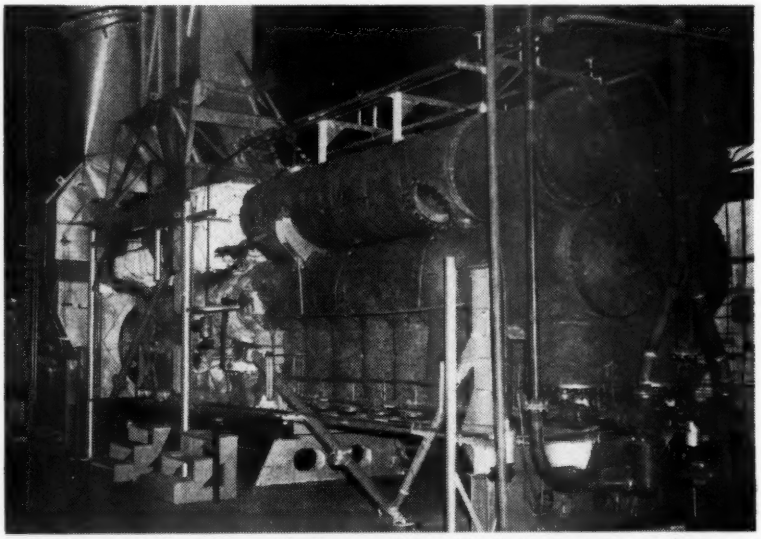
Bituminous Coal Research, Inc., continued its activities on extending the use of fly ash resulting from the combustion of pulverized coal in electric utility and industrial plants.

Conversion

Research involving the conversion of coal prior to its end use takes more than 57 percent of the total U. S. coal research expenditures. Therefore, a large group of companies and institutions are active in projects under the broad category of coal conversion.

This article classifies some of these projects and the remainder are grouped together in this paragraph. Eastern Gas and Fuel Associates conducted economic studies on extending the utilization of coal, coke, gas, and coal chemicals. The North American Coal Corp. processed coal and coal mine wastes to produce chemicals in a recently initiated project. In order to handle highly caking Pittsburgh seam coals, Pittsburgh Consolidation Coal Co. is active in the development of a new coal distillation process based on fluidized techniques.

Carbonization—In the field of low- and high-temperature carbonization, several groups in addition to the U. S. Bureau of Mines were active. Alabama Power Co. sponsored low-temperature carbonization research at Southern Research Institute. Battelle Memorial Institute reports the development of a method of determining the high-temperature strength of bulk coke. Illinois State Geological Survey published a pilot-plant study of the relative amounts of foundry-size coke which can be produced from a blend containing Illinois coal. The Institute of Gas Technology during the past year has worked on the production of electrode binder pitch from lignite tar. Pittsburgh Coke and Chemical Co. has studied various types of coal as raw



Work proceeded on the coal-fired gas turbine with efforts devoted to perfecting, developing, redesigning and testing components

material for activated carbon and protective coatings. They report the development of a novel process for making activated carbon from coal and that they are active in investigating new non-fuel uses for bituminous coal. Pennsylvania State University has investigated the relation of the chemical and fuel properties of coal tar pitch to their carbonization and graphitization properties. They have carried on development work toward the use of anthracite in carbon and graphite electrodes and the activation of anthracite. Penn State reports also that through its initial work on sulphur forms in coal and coke, it may be possible to correlate the sulphur present in coals and in coke buttons with those produced in pressure-measuring ovens by use of a conversion factor. They report a generally consistent correlation with some variations encountered with some coals. An extension of this work is planned. The Fuel Technology Department of the University of Utah, using infra-red spectroscopic methods, has carried on research to determine the mechanism of coking. Low-temperature carbonization of Virginia coal was investigated by Virginia Polytechnic Institute.

To determine the effects of variables on the products of carbonization, the U. S. Bureau of Mines conducted a number of studies of the mechanism and kinetics of coal carbonization. Problems investigated included: the effect of pretreating coal on its carbonizing behavior, the thermal decomposition characteristics of high-molecular weight materials, the role of oxygen and sulphur in coking, and the effect of pressure on coking. Changes in flue temperature, charge density, coal or blend used and moisture content, oven design, and factors influencing the rate and direction of heating were investigated to determine their effect on the quality of coke produced and the amount of pressure developed during coking.

In cooperation with several western steel producers, the Bureau of Mines conducted a number of tests to determine and evaluate the coking properties of selected western coals. The effect of temperature and bulk density on carbonizing properties was studied. To develop new uses for the noncoking western coals, a carbonizer was constructed for the production of industrial and metallurgical chars by a continuous, vertical, gravity-feed process. The coal is carbonized in a central tube surrounded by a combustion chamber. Hot products of combustion from recycle gas, burned in the annular space between the retort walls and the central tube at the top of the retort, pass through the char bed and are removed with the distillation products through the central tube, countercurrent to the coal feed. Char cooling is achieved by countercurrent make-gas flow, introduced at the base of the retort.

Studies are continuing on the use of anthracite in blast furnaces and cupolas. Research is being directed toward the production of a metallurgical anthracite briquet. A briquet has been produced in the laboratory, which, after calcination, is as resistant to impact and abrasion as either furnace or foundry coke. Briquet-forming equipment, such as auger extruders, hydraulic extruders, and roll presses, is being investigated.

Results of tests conducted on the calcination of lump anthracite in a pilot-plant calcining furnace indicated that its physical properties were improved. Materials containing less than 0.1 per cent volatile matter were prepared without difficulty in this equipment. Plans are under way for the erection of a vertical shaft pilot-calcining furnace for producing sufficient tonnages of lump anthracite and briquets for extensive tests in commercial-size blast furnaces and cupolas.

The Nova Scotia Research Foundation, in research carried out at Massachusetts Institute of Technology, sponsored work on the coking and plastic properties of Nova Scotia coals by thermo-analyses of the extracts of these coals with phenanthrene. The Nova Scotia Department of Mines has conducted low-temperature carbonization research using a rotating batch retort fashioned after the one used in the Disco precess.

Gasification—Among its coal research projects, the American Gas Association is sponsoring work at the Institute of Gas Technology on the production of pipe-line gas from coal by (1) gasification with oxygen and methanation of the synthesis gas and (2) hydrogenation of coal to methane and ethane. West Virginia University Engineering Experiment Station is conducting research on synthesis gas production from coal.

In collaboration with the Atomic Energy Commission, the U. S. Bureau of Mines has started work on the design of a gasifier for producing synthesis gas from coal with the aid of nuclear energy. The Bureau's part of this program has consisted of testing materials for their suitability as high-temperature refractories in various gaseous atmospheres and studying the reaction of coal with steam in simulated nuclear reactors. Several design ideas pertaining to such a reactor have been discussed with Atomic Energy Commission personnel. The Commission has let a contract for a reactor feasibility study.

A critical survey was made by the Bureau of Mines of the various gasification processes proposed for the manufacture of synthesis gas. The major purpose of this survey was to review the principles of coal gasification and to determine the processes to which anthracite appears to be most readily adapted.

The Bureau's work is continuing on gasification of coal with steam and oxygen under pressure. Information is being obtained with a number of coals and under a range of conditions, to determine the important variables and their effect on rate of gasification and quality of gas made.

Associated studies include an alternative method for making synthesis gas by alternately oxidizing iron (with steam) followed by a reduction of the oxidized iron (with producer gas), removal of gaseous impurities, particularly sulfur compounds, by various means, and characterization and removal of dust. An improved method has been developed for removing carbon dioxide from synthesis gas under pressure; it is now used in a plant for manufacturing ammonia.

During 1956, the project on underground gasification at Gorgas, Alabama, worked primarily on the use of hydraulic fracturing to prepare a gasification path in the coal bed. This is the third method that has been investigated to establish passages in the coal bed and comparison of the test data from the various experiments will be used to determine the most efficient method for preparing the coal bed for underground gasification. The contribution of Alabama Power Co. to this project is consulting engineering, furnishing coal in the ground for the experiment, and the land on which Government buildings and other facilities are located.

Hydrogenation—The U. S. Bureau of Mines made a number of coal hydrogenation tests in the pilot plant with particular emphasis on balanced operation. During this operation, the rate of throughput could be increased several fold over conventional rates without lowering yields. The present series of tests is designed to determine the feasibility of hydrogenating coal at about one-third the conventional pressures, 8,000 to 10,000 p.s.i.

Work at the Bureau on a smaller scale includes rapid heating of coal to high temperatures in a stream of hydrogen in an attempt to produce methane directly and also recover valuable liquid products. In addition, studies are being made of the behavior and transformations of catalysts, the reactions of coal with alkali, and the utilization and consequent degradation of coal and related substances by micro-organisms.

Fischer-Tropsch Process—With the conclusion of pilot-plant work at the U. S. Bureau of Mines on cooling of fixed catalyst beds by oil circulation, a modification of the Fischer-Tropsch process that was tried and abandoned in Germany is being investigated. In this, the hot-gas-recycle process, the heat of reaction is removed from the fixed catalyst bed by rapid circulation of synthesis gas and some gaseous

product. The process has been thought unsuitable because of the high energy requirements for pumping gas. However, with the development of active iron lathe turnings, catalyst can now be packed in the bed with 80 to 90 percent void space, resulting in a low pressure drop and considerably smaller pumping requirements.

At the same time, poisoning of catalyst by sulphur compounds is being studied at the Bureau with the thought that the sulphur tolerance of iron may be considerably higher than that of cobalt, the catalyst used in German plants and for which the specifications of sulphur content in synthesis gas were originally worked out. A number of analytical methods are being used in a study of chain-branching in the low-boiling products, which gives a clue to the quality of Fischer-Tropsch gasoline and its variation with catalyst composition and processing conditions. Among catalysts studied are not only massive iron, such as shot, turnings, and wire, pretreated by a variety of methods, but also metal oxides and alloys.

Coal Research Abroad

Major coal research programs are continuing in many countries and on most continents. Some of these were mentioned in our preceding article in this series *(Mining Congress Journal,* February 1955, pp. 92-98, 114). Most of the foreign coal research programs are increasing in size and scope, but space limitations of the present article prevent their itemized mention here. Thousands of scientists, engineers and technicians are now engaged in coal research and development work throughout the world.

During 1956, one of us visited leading coal-research laboratories and pilot plants in England, France, Germany and Holland. At the sites visited, a total of more than 2,000 persons were engaged in research and technical development work on coal. This is more than twice the total personnel similarly employed in the United States.

The scope of activities covers most every phase of coal research, for example:

Mining — Shaft sinking, methane drainage, continuous mining methods and machines, aerodynamics of ventilation, instrumentation to permit higher mining rates with increased safety, non-flammable belts, improved haulage, and the full-scale testing of mining equipment and supplies.

Preparation — Research on new methods and equipment of various types to cut costs and improve the cleaning of coal fines, high-capacity non-blinding wet screens, briquetting, and ultra-low-ash coal for carbon electrodes by controlled crushing and froth flotation of suitable coal.

Combustion—There is much emphasis on smokeless equipment and smokeless fuels for a wide range of applications from residential (fireplaces, space heaters, cookers, water heaters and central heating) to commercial and small industrial heat and power. In some areas, coking coals are reserved for carbonization, and only the more free-burning coals are used for combustion. In other areas, most all available coals are strongly coking, and these have to be used for combustion as well. High-ash fuels such as washery middlings are used for conservation reasons and economy.

Important work is being done on controlling fireside boiler deposits from the mineral constituents in coal. Fundamental studies of the combustion of pulverized coal are being made in an international research project. Research continues on removing or minimizing the effects of sulphur oxides in stack gas.

Carbonization—The preparation and blending of available coals for metallurgical coke is being intensively studied. This includes an increasing use of petrographic microscopes in evaluating coals. Large pilot-scale preparation facilities are provided which permit coal to be subjected to almost any conceivable combination of preparation and pretreatment before it is test-carbonized in large-scale ovens. There is very extensive research on coal chemicals and their utilization.

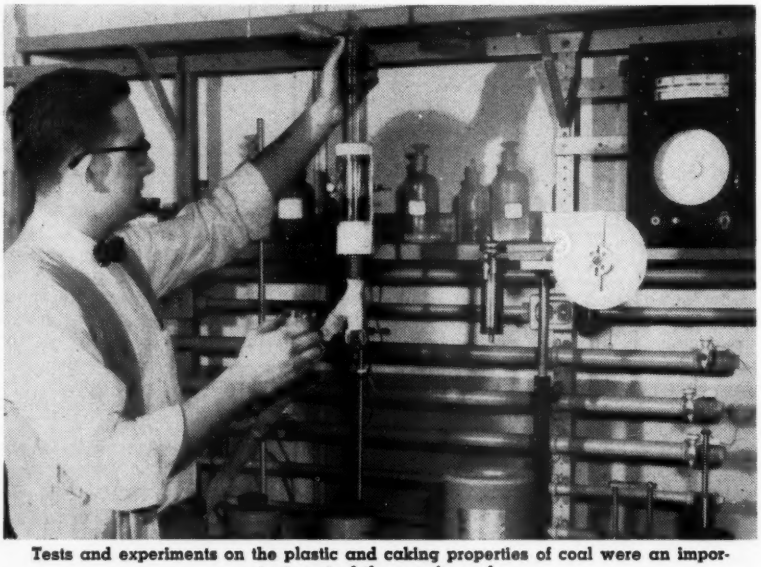
Research is continuing on the production of reactive smokeless solid fuels, including carbonized briquets, from high-volatile coals.

Gasification — Great Britain and Western Europe must use manufactured gas, since only minor amounts of natural gas and methane from coal mines are available. Coal gasification research and pilot-scale development work are proceeding on a large scale. Bituminous coal is being gasified under pressure in one plant at the rate of 1000 tons per day to make moderate Btu gas which is slightly enriched and distributed with coke-oven gas through long-distance pipe lines. "Fluidized suspension" handling of coal is being used in gasification research. Some work continues on the underground gasification of coal.

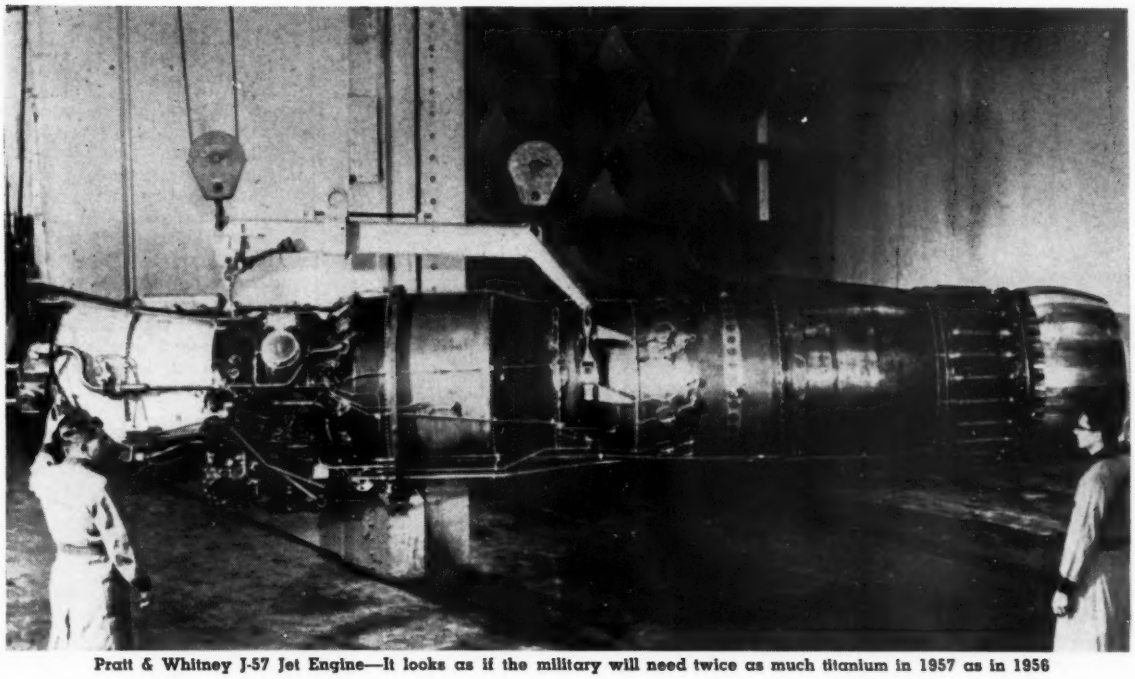
It is noteworthy that most all of the research organizations visited maintain balanced programs of (1) fundamental research; (2) applied research on the bench-scale and small and large pilot-scale; and (3) research department liaison with actual commercial use. This facilitates the practical trial and evaluation of research developments.

Coal research is expanding abroad, new coal research buildings are being occupied or are under construction, and most organizations are increasing their research staffs as fast as qualified personnel becomes available. The latest techniques are employed, and much fine electronic, optical and automatic-testing equipment is in use.

The coal research programs abroad are financed variously by coal producers, large coal users, equipment manufacturers, government agencies, etc. Much of the work is done in research centers operated by industry associations, with varying degrees of government participation. The expenditures for all types of research, whether fundamental or applied, are looked upon as business investments which are for the healthy development and financial security of the industries concerned, and for the public security and welfare.



Tests and experiments on the plastic and caking properties of coal were an important part of the year's work



Pratt & Whitney J-57 Jet Engine—It looks as if the military will need twice as much titanium in 1957 as in 1956

Titanium 1956-57

Instead of the predicted 50 percent increase over 1955, the demand for titanium in 1956 jumped more than 300 percent. Although the aircraft industry was largely responsible for this expansion, other industries are finding a rapidly increasing number of uses for this metal

By C. I. BRADFORD
President
Rem-Cru Titanium, Inc.

Major factors in the healthy growth of the titanium industry have been analyzed by C. I. BRADFORD, president and general manager of Rem-Cru Titanium, Inc. He has been associated with the relatively new industry since 1947 and is a recognized authority on titanium.

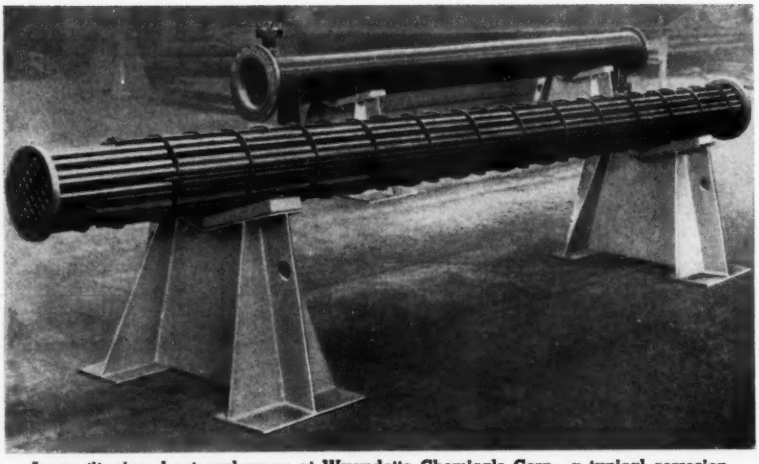
THE year 1956 can be summarized as the year in which the aircraft industry gave titanium a solid vote of confidence as a standard engineering material for production components. This vote of confidence resulted in a threefold increase in demand for titanium mill products in 1956 over 1955. Final shipment figures should clear the 5000-ton mark. The same trend appears certain to continue in 1957. A minimum demand of 10,000 tons of mill product is our present estimate, and the titanium industry is believed to be able to respond to this challenge by achieving a reasonable supply and demand balance before the end of 1957.

This acceptance of titanium's tonnage status in military and civilian aircraft comes just five years after titanium's first flight test—in an F-84 airplane in 1951. During succeeding years, production of mill products increased at a rapid rate, but with most of the metal being used for experimental or prototype work.

No Longer Experimental Metal

At the end of 1955, the record showed a total production for that year of about 2000 tons of sheets, bars, billets and other forms of wrought titanium. The best industry and government forecasts for 1956 indicated a demand for about 3000 or, at the most, 3500 tons. But, suddenly, titanium no longer was an "experimental" metal. Several types of airplanes using significant quantities of titanium began to come off the lines in large numbers, and jet engines with titanium compressors suddenly became quite popular, giving excellent accounts of themselves in service.

The result was startling. Instead of the quite respectable 50 percent increase over 1955, demand jumped by a factor of over three. By expanding its capacity under forced draft, the industry turned out about 5000 tons of mill products. For 1957, the present best guesses indicate a military need



Large titanium heat exchanger at Wyandotte Chemicals Corp., a typical corrosion resisting application

for at least double the 1956 figure. Present expectations are that these goals will be met.

Behind this optimism is the assurance of adequate supplies of raw materials for 1957; however, if the present rate of increase in demand continues, additional sponge facilities will be required. The situation as it is expected to exist by mid to late 1957 is:

Sponge Producer	Annual Capacity (tons)
Cramet, Inc	6,000
Dow Chemical Co.	1,800
E. I. du Pont de Nemours & Co., Inc.	7,200
National Distillers, Inc.	5,000
Titanium Metals Corp. of America	9,000
Union Carbide and Carbon Corp.	7,500
Total Capacity	36,500

Increased Melting Capacity

Another development in the sponge picture was the joint announcement by Allied Chemical and Dye Corp. and Kennecott Copper Corp. to form a new company for the production of titanium. An initial investment of $40,000,000 is planned, and production of sponge and billets is scheduled to begin late in 1958.

In addition, Japanese firms expect to continue or increase their 1956 production rate of 2500 tons, and there is a healthy cushion in the government-owned rotating stockpile.

The four major producers of titanium mill products have all announced expansion of melting facilities to meet increased demand during 1957. These producers are Rem-Cru Titanium, Inc., jointly owned by Remington Arms Co., Inc., and the Crucible Steel Company of America; Titanium Metals Corporation of America; Mallory-Sharon Titanium Corp.; and Republic Steel Corp.

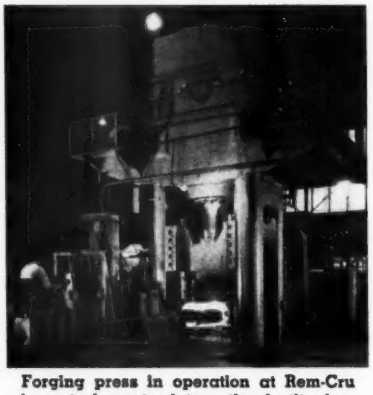
At Rem-Cru, we are continuing what we believe to be an essentially sound expansion program based on this increased demand. By the second quarter of 1957, our melting capacity will be 6000 to 7000 ingot tons per year. In view of the industry's increased melting capacity, we expect, barring presently unforeseen additional requirements, that there will be considerable improvement in delivery schedules during 1957.

In addition to the production breakthrough, other significant advances were made at Rem-Cru during 1956. For example, the company signed a three-year labor contract to provide uninterrupted production schedules in the years ahead. All melting furnaces were rebuilt to provide optimum safety and eliminate delays due to equipment failure. New facilities were installed, including additional melting furnaces, forging equipment, billet finishing equipment, and many other specialized items such as a large vacuum annealing furnace, all of which were put into operation in Rem-Cru's own plant at Midland, Pa.

New vacuum annealing furnace at Rem-Cru Titanium, Inc., Midland, Pa.

Research

The year 1956 was an important one in titanium research and development, which will continue to be major factors in the healthy growth of the industry. At Rem-Cru, our programs made excellent progress. In the alloy development field, where Rem-Cru research has made so many contributions which have resulted in today's standard alloy grades, improved and totally new alloys are in pilot production, with excellent preliminary results. In melting development, our improvements in cold mold melting have been carried out simultaneously with an extensive and very promising program on unconventional titanium melting methods.

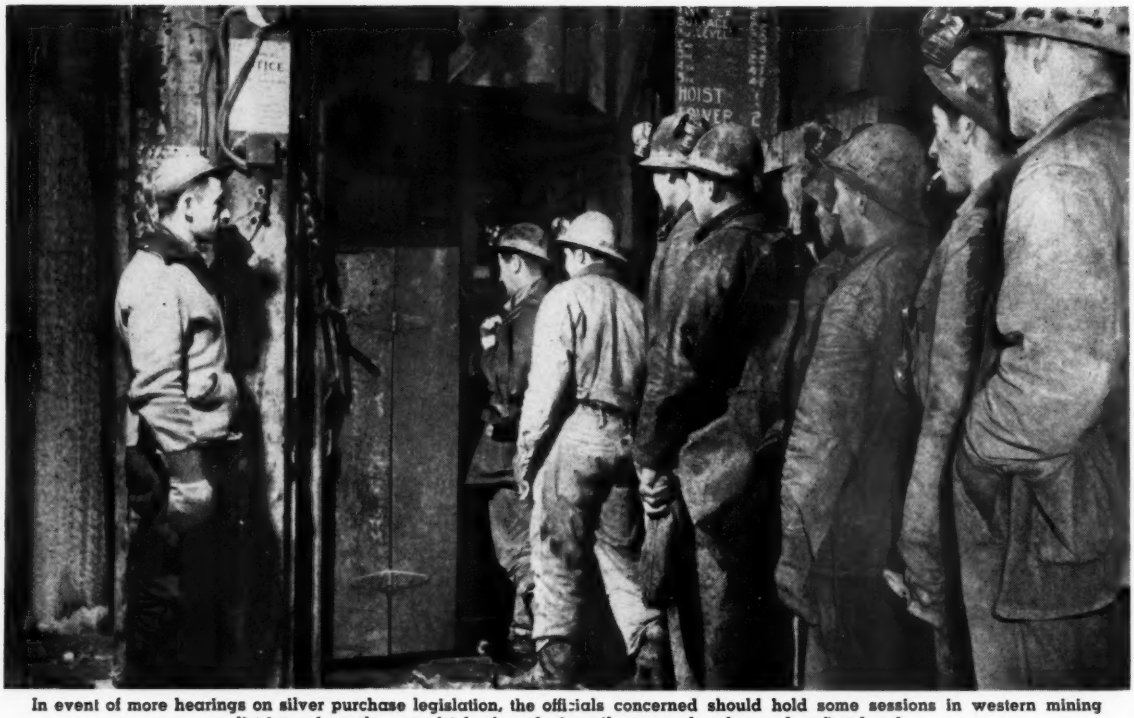


Forging press in operation at Rem-Cru is part of greater integration in titanium industry

New Uses Developed

During the year, many new commercial uses for titanium were developed by working with designers of chemical process, paper manufacturing, marine, metal-finishing and electronic equipment. These industries are finding a rapidly increasing number of uses for titanium. Standard assemblies and equipment (heat exchangers, reactors, mixers, pumps, valves, marine hardware) are being produced for these industries in titanium. Generally, these assemblies have been considerably less than anticipated in terms of price. In terms of cost, calculated by service life, maintenance and downtime, most titanium installations are producing greater savings than expected even on optimistic first estimates.

Just as the performance of titanium in prototype aircraft has led to its acceptance in the aviation industry, so we believe that the performance of these prototype installations in non-defense applications will soon multiply the number of industries which consider titanium a basic and important material of construction.



In event of more hearings on silver purchase legislation, the officials concerned should hold some sessions in western mining districts where the actual job of producing silver may be observed at first hand

Silver Again In The Spotlight

Highlights that appeared on the silver horizon in 1956 were defeat of the attempt headed by the Silver Users Association, to repeal all so-called silver purchase legislation; an increase over 1955 in the domestic production of silver; a continuing expansion of silver coinage for domestic use; and a considerably higher rate of ore and base bullion imports

By W. M. YEAMAN
President, Clayton Silver Mines, Inc.

THE increased consumption of silver by various industries is of considerable importance, and indications are that consumption in 1957 by the arts and industries will show a still further increase. Noteworthy also is the return to the United States of substantial quantities of silver lend-leased to friendly foreign countries during World War II. Further repayments of lend-lease silver are expected to resume in 1957, and probably for the next year or two until all of it will have been repaid.

Senate Hearings

Silver hearings begun on July 13, 1955, before the Subcommittee on the Federal Reserve, Committee on Banking and Currency of the Senate, were resumed on January 10, 1956. The hearings in 1955 were confined to testimony offered by proponents of the bill (S. 1427) to repeal certain legislation relating to the purchase of silver, and for other purposes, while the testimony on January 10, 1956, came from the opponents of the bill.

The 1956 hearings were attended in person by Senators Douglas (Ill.), Chairman, Robertson (Va.), and Bennett (Utah), Members of the Subcommittee, and Senators Bush (Conn.), Hayden (Ariz.), Dworshak (Idaho), Green (R. I.), and Allott (Colo.).

Senator Hayden presented what he termed a "fine factual statement" prepared by Charles F. Willis, State Secretary, Arizona Small Mine Operators Association, which was printed in full in the hearings, and then explained to the Subcommittee how the Treasury makes a substantial profit on every ounce of silver acquired from domestic silver miners; and that the silver content of the base metal ores plays an important role in the production of those metals.

After Senator Bush spoke briefly in favor of the bill, Senator Dworshak presented impressive arguments against its enactment, and submitted a communication in support of his views from Harry W. Marsh, secre-

tary, Idaho Mining Association. Senator Allott also addressed the Subcommittee and endorsed the remarks of Senators Hayden, Dworshak and Bennett. Although Senator Green was invited to testify, he declined.

A scholarly statement by Dr. Elgin Groseclose, economic counsel, in opposition to the bill was transmitted to the Subcommittee and incorporated in the hearings. Other statements in opposition to the bill were presented by Senators Chavez (N. M.), Welker (Idaho), Bible (Nev.), Malone (Nev.), Murray (Mont.), Mansfield (Mont.), and by Julian D. Conover, executive vice-president, American Mining Congress, Carl H. Wilken, economic analyst, Raw Materials National Council, Simon D. Strauss, vice-president, American Smelting and Refining Co., Tom Lyon, Western Governors Mining Policy Conference, and (through Senator Murray) by the late Carl J. Trauerman, secretary, Montana Mining Association.

Senator Bennett submitted a statement against enactment from Clark L. Wilson, vice-president, New Park Mining Co.; S. K. Droubay, general manager, United Park City Mines Co.; Cecil Fitch, Jr., vice-president, Chief Consolidated Mining Co.; also from Miles P. Romney, manager, Utah Mining Association.

Senator Magnuson presented a statement from Karl W. Jasper, president, Northwest Mining Assn., which, in addition to opposing the enactment of the bill, enclosed a copy of the recommendations of the Western Governors Mineral Policies Conference held at Sacramento, Calif., November 7-8, 1955, strongly urging defeat of the bill; and that the sale of silver for industrial uses be prohibited; that the seigniorage retained by the Treasury Department be progressively reduced; and commending the Governors and legislators of the western states "for the vigorous support which they have given to the silver mining industry."

Senator Welker submitted a comprehensive statement in which he pointed out the important part played by silver in industrial fields; in supplying through lend-lease over 410 million oz to friendly countries during World War II, to industry in this country 135 million oz, and to Defense Plant Corporation 902 million oz for use as bus bars in Government-owned plants which produced aluminum and other materials for war uses.

Senator Chavez presented a letter addressed to him by C. H. Murphey, executive director, New Mexico Mining Assn., urging rejection of S. 1427 and explaining the need for revenue from the sale of the silver content of the ores in order to continue production in some of the mines in New Mexico.

Senator Bible submitted a statement in which he emphasized that the passage of this bill would repeal the requirement that additional silver certificates be issued and the obligation to acquire newly mined domestic silver at a price below the market price; that the Treasury under the terms of the bill could retire silver certificates at a rate sufficient to release monetized silver to be converted into subsidiary coinage; and that the retirement of silver certificates would remove the last vestige of currency convertibility remaining in the United States, cause disastrous inflation and a drop in the price of silver of at least 25 percent, thereby reducing domestic production of silver and many other strategic and critical metals below a safe mobilization base. He said this would result in unemployment, loss of new wealth and tax base and cause the United States to rely upon overseas sources of critical raw materials. Also submitted by Senator Bible was a sound statement from Louis D. Gordon, executive secretary, Nevada Mining Assn., in which he drew a graphic picture of the probable destructive results that the passage of the bill would impose on the economy and welfare of the mining industry of Nevada and the other western states. He also said "It seems rather ironic that the farmers are guaranteed prices for their products . . . and other industries subsidized, but the purchase of silver is condemned and deplored, even though the Government, instead of losing money, makes money on every ounce of silver purchased and coined."

In the statement submitted by Senator Malone he reviewed the use of silver as money throughout the world and referred particularly to the crisis that developed in India in 1918 which prompted the British Government to urge the United States to supply India with 200 million oz of silver to be coined into rupees to enable the Bank of India to redeem paper rupee notes which were being offered at such an alarming rate for redemption in silver that the authorities feared the "run" would cause the closing of the banks, with resultant riots and revolution by the natives in the event of failure to meet the demand for note redemption. He cites the action taken by the United State Government in melting down 260 million silver dollars and selling the resultant silver to India at $1.00 an ounce, followed by the purchase of 200 million ounces from domestic miners at $1.00 an ounce to replace the silver sold to India.

Senators Murray and Mansfield submitted a joint statement which indicated that the passage of the bill would weaken the monetary position of the United States and seriously injure its mining industry in the production of critical and strategic metals so badly needed for the national defense in the past and may be highly essential in the future. Their statement listed twelve copper operations in Arizona, Montana, Nevada, and Michigan which also produce silver as a byproduct, and stated that the passage of the bill could in many cases force a shut-down of the properties.

William M. Yeaman entered the silver mining industry in 1930 when he and the late Wilbur Greenaugh organized the Clayton Silver Mines in south central Idaho. He became president of that company in 1942. Yeaman is also president of the Sunshine Consolidated, Inc., and Silver Syndicate, Inc., companies which have operating properties at Kellogg, Idaho, and have more recently started developing a uranium property in southern Utah. In 1948 Yeaman became interested in the Roslyn Cascade Coal Co. at Roslyn, Wash., and serves as its secretary and treasurer. Yeaman states that the Roslyn operation, although small, has been highly successful.

The statement of Simon D. Strauss revealed that silver is a basic product of his company and that it is sold in the open market as well as delivered to the U. S. Mint. He then gave the five following reasons why the bill should not be enacted into law: (1) It is consistent with the traditional American belief in a hard currency, as contrasted with a managed currency; (2) it is not a subsidy, as its opponents charge, but on the contrary is a source of revenue to the Government; (3) it provides the Nation with a stockpile of a material of vital importance in the defense effort, as proved by events in World War II; (4) it encourages the maintenance of domestic mining activities that yield substantial quantities of other strategic metals; and (5) it has no significant effect on the cost of articles purchased by the ultimate consumer.

Enclosed with the letter opposing enactment of the bill from the late Carl J. Trauerman to Senator Murray were other statements from C. L. Hewitt, Swansea Mines Inc., and Boss Mines, Inc.; Robert H. Nelson, Norwich Mine; A. V. Taylor, Jr., The Taylor-Knapp Co.; J. A. Allen, Lexington Silver-Lead Mines, Inc.; L. B. Manning, American Machine and Metals Co., Trout Mining Division.

In the statement of the American Mining Congress, a national organi-

zation representing all branches of the mining industry throughout the United States, Julian D. Conover, in opposing the enactment of the bill, states that a declaration of policy adopted at its annual convention meeting at Las Vegas, and subsequently ratified by the Board of Directors, commended the policies of the United States Government that have contributed to the inclusion of silver as a monetary metal, and urged the continued acquisition of domestic silver by the Treasury for monetary needs, and that the stocks of silver so acquired be held inviolate for such purposes.

Carl H. Wilken, Economic Analyst for the raw Materials National Council, in opposing the enactment of the bill stated that a study of raw material prices made by the Council led to a relative study of monetary practices throughout the world and their effect upon commodity prices. He reviewed the so-called demonetization of silver in 1873 and the long period of bimetallism preceding it when two-thirds of the world's population had internal monetary systems based on silver. He said it is his opinion "based on the record of commodity prices following * * * 1873, and the manipulation of silver prices in 1919-20 and following 1925, that the price of silver was one of the chief causes of depressions and of the economic conflicts which led to World War I and the depressions of 1920 and 1929-41." He further stated that "the failure to restore silver as a monetary medium led to the Second World War and the collapse of China and much of the British Empire."

In the statement submitted by Dr. Groseclose, he said that the principal result of the passage of S.1427 "would be the effective demonetization of silver in the American monetary structure," and that "demonetization of silver would represent a drastic change in our historic and traditional monetary system." He pointed out that during both World War I (Act of April 23, 1918) and World War II (under lend lease) the United States furnished large quantities of silver to India at the request of Great Britain, which country had shifted its monetary base to gold and "had allowed its silver reserves to well nigh disappear."

He stated that the enactment of S.1427 would discourage the wider use of silver as money instead of the use of flat paper, managed currency and illusory gold-backed notes.

Governor Russell of Nevada on January 23, 1956, sent a telegram to Senator Douglas, Chairman of the Subcommittee, "strongly" opposing enactment of S.1427 as imposing serious threat not only to the mining industry of Nevada but also other western states.

The Subcommittee met on June 5, 1956, to vote on a motion to report the bill favorably to the Banking and Currency Committee. The motion was lost by a vote of 6 to 1, and thereby the bill was defeated.

If the Senate should again elect to hold hearings on legislation designed to repeal the so-called silver purchase acts, this author recommends that the committee having jurisdiction over this subject convene one or two sessions in the western part of the United States where its members can visit the mines, talk with miners directly and take first hand testimony on the ground.

Production and Consumption

The following tabulation shows domestic production, in fine ounces, by States in 1956:

States east of the Mississippi	676,713
Missouri	268,620
Western States:	
Arizona	4,634,179
California	954,181
Colorado	2,772,073
Idaho	13,831,458
Montana	6,080,390
Nevada	845,397
New Mexico	251,072
Oregon	8,815
South Dakota	154,092
Texas	126
Utah	6,250,565
Washington	436,348
Wyoming	20
Alaska	33,693
Total	37,197,742

Of the 37,197,742 oz. produced domestically in 1956, only 15,649,584 oz. were acquired by the Treasury at 90.5 cents, the balance being sold directly by the miner to industry at higher prices.

In 1955 domestic production was 36,469,600 oz., which was approximately two percent under the 1956 production.

The best estimate available of world production in 1956 is 225 million oz.

Silver Market

The New York market price of silver in 1956 opened on January 2 at 90½ cents an ounce, which is identical with the Treasury's buying price of domestically mined silver. The price fluctuated many times during the year, but always within a very narrow range, from a low of 90 cents on January 23 to 90-⅝ cents on February 17, ending on December 31, 1956, with a strong demand at 91-⅜ cents an ounce.

Silver Market in India

The Indian Government's refinery under construction for the past two years is yet to be completed, and it is planned to refine the silver rupee coins withdrawn from circulation during the past three years and use the silver so extracted to repay its silver lend-lease debt to the United States in the amount of 225,999,904 oz. Newly minted supro-nickel coins will replace the silver coins withdrawn.

The market price in Bombay in 1956 was less stable than in New York. Fluctuations in that market ranged from a high of 183 rupees, 13 annas per oz. in March to a low of 168 rupees 11 annas in June. This is equivalent in U. S. dollars to $1.02 and $0.95 respectively.

The Government of India recently announced that import licenses would be issued by the Reserve Bank of India permitting the importation of any silver coin which is current in the Tibet region of China, also that the import duty on such silver coin would be increased from 4-1/5 annas to 8-2/5 annas per oz.

Treasury Acquisitions and Sales

During the year 1956 industrial users of silver purchased 3,273,475 oz. from the Treasury, which is only about one-third of the amount (10,289,403 oz.) they purchased from the Treasury in the previous year. The price paid for this silver was $0.91 an ounce, the Treasury's offering price established in 1946. Sales of "free" silver by the Treasury to other Government agencies during the year amounted to 41,687 oz.

The Treasury acquired a total of 15,649,584 oz. in 1956 from domestic producers, 10,954,709 oz. of which were "coined" by issuing silver certificates against this amount, and the balance of 4,695,875 oz. were committed to the seigniorage (profit) fund. (Under the 1946 law the profit derived by the Government is 30 per cent of the total silver acquired from domestic miners; the 70 per cent is immediately monetized and silver certificates in an amount equal to the cost placed in circulation forthwith.)

No foreign silver has been purchased since 1942 under the Silver Purchase Act of 1934.

Seigniorage Fund Increases

As a result of the substantial repayments of lend-lease silver the seigniorage fund of the United States Treasury rose from 13,596,322 oz. on December 31, 1955, to 87,417,500 oz. on December 31, 1956. This fund also benefited from acquisitions of domestically mined silver (from January to November) in 1956 in the amount of 4,694,875 oz., plus 1,497,877 oz. of "bullion ordinary" contained in gold deposit receipts, and 2,802,188 oz. from melted unfit coins for recoinage. Silver from melted coins is carried in an account called "Free Coinage Account Silver," and cannot be sold at less than $1.38 an oz., the monetary value of silver in subsidiary coins. This silver is remanufactured into new coins, and the seigniorage derived from silver contained in sub-

Last year the domestic coinage rate was more than three times as high as in 1955

sidiary coinage is nine cents an ounce greater than that in the silver dollar.

This fund is the source of silver used by the Bureau of the Mint for silver coinage and of silver sold for industrial use in the United States. It was also the source of the 410,814,344 oz. lend-leased to eight countries during World War II.

Coinage

Domestic coinage consumed 27,614,838 oz. of silver in 1956, compared with 8,200,000 oz. in 1955, or over 300 percent increase in subsidiary coinage.

It has just been learned that the demand for newly minted domestic silver coinage in 1957 will be much greater than in 1956 but no estimate of the amount has been made public by the Treasury at the time this article went to press.

It was announced in November that Uruguayan silver coins with face values of 1 peso, 50 centavos, and 20 centavos have been withdrawn from circulation as a result of the decline in the "Free" market exchange rate (from Ur$2.70 per U. S. dollar in September 1952 to Ur$4.20 in October 1956). The value of the silver content of these coins now exceeds their face value, and some of them are reported to have been melted down.

Status of Lend-Lease Silver At End of Year

Among the other important events concerning silver in 1956 was the return of 63,665,065 oz. of silver lend-lease during World War II to Great Britain, and of 18,167,106 oz. lend-leased to the Netherlands. Australia also returned 10,006,000 oz. in partial repayment of her silver lend-lease debt but the shipment arrived too late in December to be taken into account in 1956. Great Britain also shipped 4,058,581 oz. to the United States to apply on her silver lend-lease debt which also arrived too late to be taken into account in 1956.

The status as of December 31, 1956, of the silver lend-lease transactions is as follows:

	Amount Lend-leased	Amount Repaid	Balance[1] Due
Australia	11,773,093	NONE	11,773,093
Belgium	261,333	261,333	NONE
Ethiopia	5,425,000	NONE	5,425,000
Fiji	196,364	NONE	196,364
India	225,999,904	NONE	225,999,904
Netherlands	56,737,341	46,254,758	10,482,583
Saudi-Arabia	22,347,431	NONE	22,347,431
United Kingdom	88,073,878	63,665,065	24,408,813
	410,814,344	110,181,156	300,633,188

[1] Australia returned to the Treasury during December 10,006,000 oz which arrived too late to be taken into account in 1956. This amount will be formally assayed and taken into account in January of 1957, leaving a balance due from Australia of 1,767,093 oz; and Great Britain returned 4,058,581 ounces which also arrived too late in December to be taken into account in 1956, leaving a balance due from that country of 20,350,232 ounces.

Industrial Consumption

Industrial demand continues to climb and the uses multiply. Estimated consumption for 1956 was 103,000,000 oz., with industrial arts using approximately 40,000,000 oz., coinage 27,614,838, and miscellaneous uses including solders, alloys, wire, contacts, etc. absorbing the balance. The high conductivity of silver has played an important part in the increased industrial demand for this precious and important metal, due largely to the sales of television, radio and other electronics equipment.

Two new additions to their line of silver zinc batteries have been announced by Yardney Electric Corporation of New York, the LR 200 and LR 300. The latter, which substitutes silver for nickel, has a capacity of 300 ampere hours at a nominal voltage of 1.5 volts. It weighs only nine lb-four oz. when filled and is about 20 percent of the size and 16 percent of the weight of a nickel-cadmium battery of equivalent power. The LR 200, although originally developed for marine applications, is now being used in a battery supplying consecutive starts for multi-engine bombers.

A high silver content alloy blended with special flux in convenient paint-on form has been developed by Eutectic Welding Alloys Corp., which is used for preplacement, tinning, filling, overlaying and joining on all metals except aluminum, magnesium and the white metals. It is applied with a brush or spatula. It is a paste and is particularly recommended for silver soldering or silver brazing.

The publication, "Materials and Methods," states that "Silver plating has become important for a number of industrial applications, such as electrical contacts, corrosion resistant containers in the chemical and food industries, and high load sleeve bearings in aircraft."

An alloy of 99.50 percent silver, 0.30 percent magnesium and 0.20 percent nickel has been developed by Handy and Harman for extensive use in the electrical and electronic fields. The company states that this alloy provides high hardness and low creep rate at elevated temperatures.

Imports and Exports

The year was a big one in international movements of silver in and out of the United States. The quantity imported as usual far exceeded exports. The great majority of the imports came from Canada, Mexico, Bolivia, Guatemala, Honduras, Peru, Great Britain, The Netherlands, Saudi Arabia, Lebanon and Australia. These imports include lend-lease silver returned from The Netherlands, Great Britain and Australia. The total imports and exports from January to November are shown above.

IMPORTS	
Ore and base bullion	60,199,418 oz
Bullion, refined	91,532,901 oz
U. S. Coin	663,372 oz
Foreign Coin (dollars)	$1,051
EXPORTS	
Ore and base bullion	571,096 oz
Bullion, refined	3,303,141 oz
U. S. Coin	149,021 oz
Foreign Coin (dollars)	$1,776,494

Mineral Dressing in 1956

Milling advances have played an important part in bringing the U. S. to the point that much of our metal production is from ores that would have been called waste rock a generation ago

Trend is to larger, better designed mills with bigger equipment in a move to reduce milling costs

By NATHANIEL HERZ
Consulting Metallurgist
Lead, S. D.

After a year of teaching in the metallurgical department at Yale University, NATHANIEL HERZ joined Homestake Mining Co. in 1911 at Lead, S. D., in the metallurgical department. With the exception of time out for service during World War I, he worked with Homestake continuously until 1954 when he retired. He was chief metallurgist for the gold producer during the last 12 years of his employment with that company. Since 1954 he has been engaged in private consulting practice, much of which has been in uranium. In April 1956 he was awarded a certificate of meritorious achievement by the South Dakota School of Mines & Technology "for outstanding service to the State in science and engineering."

THE year was one of normal steady progress in many phases of mineral dressing, without any extremely startling innovations. With most of the major metal prices well stabilized during the year, except for copper and steel which decreased and increased respectively, and the persistent rise in the cost of labor and supplies, a great deal of attention was given to means for increasing efficiency and economy. This has led to continuing improvement in design and construction of equipment for milling, and to operational changes that are gradually altering the milling picture as well as affecting the subsequent processing of the mill products.

Mills Becoming Larger and More Complex

Tonnagewise, iron and copper ore milling are increasing most rapidly among metals, while phosphate probably leads the non-metals (unless coal-washing is included). Percentagewise, hydrometallurgy shows a great increase in the processing of uranium ores, but little gain in other fields. The trend in all mineral dressing is toward bigger plants equipped with larger equipment. The small mill of 25 or 50 tons daily capacity has almost disappeared with the exhaustion of bonanza type ores and with labor and other costs at their present highs. For treatment of most ores of moderate grade, a mill should have a capacity of at least several hundred tons per day to operate at a cost sufficiently low to be economically successful.

Larger milling plants operate with a lower overhead cost per ton as compared with smaller plants, and can afford better technical personnel. In addition, operating labor is used more efficiently with each operator taking care of more units or larger ones. Power efficiency is generally greater in the case of larger machines, especially if used up to their full capacity, and supply costs per ton milled are always lowered by larger scale processing. Therefore, it is reasonable to assume that the trend to larger plants with larger individual machines must continue to keep up with the pace of the times.

Controls of various sorts are replacing rule of thumb and guesswork. The completely automatic plant is impossible in most cases without practically complete control over the physical,

chemical and mineralogical character of the ore coming into process, but many mills make good use of automatic controls such as weighing feeders, water or reagent proportioners, etc. Also, more instrumentation is being used by millmen to insure uniformity of control—flowmeters of various sorts, automatic recorders for such items as tonnage fed, pH of flotation circuits, water and air flow rates, etc. being in common use in modern installations. Sometimes these meters may be interlocked with controlling equipment for automatic regulation of pH, temperature, reagent quantities, etc., making an approach towards automation. Present objectives, however, are higher efficiency and reduced cost of operation, with some automation as a by-product.

Crushing Needs Study

Crushers and grinding mills continue to be built both bigger and better, with enormous gyratories in use for primary crushing in the taconite mills. Some day we may know enough about what really happens in a crusher or grinding mill to design machines of greater mechanical efficiency than those now in use, although the writer believes that present-day equipment is not as low in mechanical efficiency as was claimed by some writers several years ago. Research such as that described by R. J. Charles ("High Velocity Impact in Comminution," *Mining Engineering*, October 1956) is of considerable interest. With brittle materials, low velocity impact or slow compression may produce a larger size reduction than high velocity impact of the same energy value, but high velocity impact produces a more uniformly sized product. The current research project may bring out the actual mechanical efficiency of commonly used equipment, and lead to important improvements.

The Aerofall mill has not had as much publicity in 1956 as in preceding years. It is in use in several milling plants, and its theory is extremely interesting, with a great saving in steel by using some of the rock particles themselves as crushing and grinding media, taking the wear usually assumed by metal parts. However, this machine does take a rather large amount of accessory equipment to circulate the load and remove the material that is ground sufficiently fine to be sent on to further treatment. These accessories could easily offset the gain in the mill proper, unless justified by some superior characteristics of the product for specialized projects.

Cyclones are becoming increasingly popular for desliming and classification. As they are increased in size, they operate at lower water pressures and velocities, reducing both power requirements and abrasion troubles. These improvements, plus the low first cost, make the installation of cyclones appear attractive, and in many instances they are doing their work effectively.

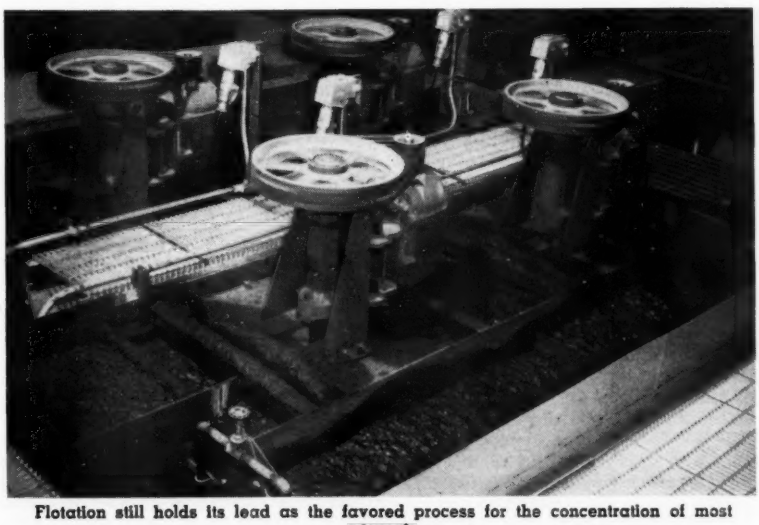
Concentration Gets Attention

Flotation still holds its lead as the favored process for the concentration of most minerals, and will probably continue to do so for the forseeable future. It is seeing expanded use in the non-sulphide field as more is learned about the action of a variety of reagents on such minerals in pulps of varying character. One of the fields left open for much further research is the treatment of low-grade base metal oxidized ores.

Magnetic concentration is increasing rapidly in the treatment of magnetic taconites on the iron range, while flotation is responsible for a growing production of hematite from iron ores of moderate grade.

Gravity concentration by jigs is used for recovery of coarse free mineral where it exists in sufficient quantity, but this represents a small amount in comparison with the enormous tonnages of flotation concentrate produced. Still, a few minerals are better adapted at the present state of the art to gravity recovery by jigs, tables and other means until such a time as the proper flotation conditions may be found. One gravity separation practice that is making considerable progress is the use of Humphrey spirals. These were invented many years ago for recovery of fine free gold; they operate economically and make an excellent separation of fine minerals of high density from lighter gangue material. They are in use for the treatment of natural sands or for further treatment of mill tailings, separating such minerals as zircon, ilmenite, rutile, cassiterite, scheelite and many others of high specific gravity from lighter gangue.

This giant 60-in. gyratory crusher weighs 1,200,000 lb and reduces four-ft chunks of taconite to minus eight in. at the rate of 300 tons per hour—further evidence of the trend towards larger and larger crushing equipment



Flotation still holds its lead as the favored process for the concentration of most minerals

Big News in Hydrometallurgy

In the field of hydrometallurgy, the biggest news of 1956 was in the uranium industry—ore processing information was declassified by the Atomic Energy Commission, and later the plant tonnages were also declassified. Processing tonnage doubled during 1956, with the present annual capacity pegged at 3,000,000 tons. New construction of an additional 1,500,000 tons of capacity is in progress or authorized, and still more is being considered or is already under negotiation.

The one process of universal application, suitable for treating any uranium ore, has not been found, although it has been a much sought objective for some ten years. Since uranium in

siliceous ores of the carnotite type is readily extracted by sulphuric acid of moderate strength, and since limestone or other ores of high calcareous content consume acid in uneconomic quantities while yielding their uranium in most instances to hot solutions of sodium carbonate plus some bicarbonate, these two constitute the basic uranium extraction processes for most ores. Variations include roasting, with or without salt for some ores (salt is used when vanadium is present in quantities sufficient to make its recovery desirable), moderate temperature calcination, autoclaving for carbonate leaching (or treatment at atmospheric pressure), the use of chemical oxidants or compressed air, as well as many variations in the recovery of the uranium from solution. Recovery from acid solutions may be by chemical precipitation (now fast becoming obsolete), by ion exchange from clarified solutions, by ion exchange using resin-in-pulp methods, and also by solvent extraction. From carbonate solutions the usual procedure is the precipitation of uranium as sodium diuranate by the addition of caustic soda in a quantity sufficient to convert all bicarbonate into normal carbonate plus a small excess.

It may appear that too much space is here being given to a specialized industry of relatively small tonnage, but the writer wishes to bring out a few points of interest. Many uranium ores contain considerable argillaceous material, often bentonitic in its character. Sometimes the dilute sulphuric acid leaching produces more colloids, while sodium carbonate is an excellent dispersant for slimes. These conditions brought into being a major slime problem in the uranium industry, which stimulated much research resulting in a great improvement in the flocculating agents now available to millmen. This, in turn, has led to more effective thickening and/or filtration procedures in many industries, including mineral dressing.

Another development that came from the uranium industry that may well be modified so as to be of value in other fields is the resin-in-pulp ion exchange process, of particular use in the processing of ores producing extremely colloidal slimes of the most troublesome nature. The most recent uranium recovery process that has been developed to the point that its use may be found of value in other hydrometallurgical fields is that of solvent extraction. Experience gained in the operation and design of new equipment for use in uranium work may result in its adaptation to the extraction or purification of other metals.

When uranium processing on an increased scale became necessary for the safety of our country after World War II, it was "top secret" and plants were designed for vanadium extraction by salt roasting and water leaching, with a uranium extraction plant added to the flowsheet. Since few experienced hydrometallurgists were then available (excepting those busy in the limited number of operating plants) chemists and chemical engineers from other fields were called upon to do much of the research and testing work. This was generally well done on a laboratory scale, but the enlargement to plant scale required a change of thinking about many features. It is interesting to meditate upon the fact that a hydrometallurgist, John V. N. Dorr, was largely responsible, half a century ago, for embarking the youthful chemical industry of the United States on its successful career of large scale continuous operation. He brought to it some of the machines and principles developed in hydrometallurgical plants for continuous operation. Now, fifty years later, chemists and chemical engineers are working with hydrometallurgists in a new metallurgical industry and are bringing processes relatively new to hydrometallurgists into use in their milling plants.

Spirals have become increasingly popular where the problem is to separate a fine, relatively high density material from a light gangue

A Look Back

Let us look back over this last half century for a moment and see what major changes have occurred. Perhaps the most consequential was the development of the flotation process, first as a producer of a bulk concentrate but soon after as a highly selective separatory process. The effects of this development were many; one of the greatest was the elimination of the blast furnace in most copper smelting, and the substitution of large reverberatories with much greater capacity. The replacement of coarse ore of relatively low grade by high grade concentrate also has had its effect upon lead smelting, while the better quality and purity of zinc concentrate has improved zinc smelting. The combination of higher mill recoveries and better concentrates, along with better smelting conditions, has made many lower grade ores profitable for large scale operation, so today much of our metal production is from what was waste rock a generation ago. A part of the credit for this advancement should certainly go to the mill operators and to others who worked upon the improvements in processing ores.

Another growing field for the mineral dresser is iron ore processing. Here we had ore washing plants for many years, doing their work well, but now we also have the large taconite plants producing concentrates containing over 60 percent iron from what was formerly considered worthless waste. These concentrates, being around 300 mesh in grain size, would be useless as blast furnace feed were it not for pelletization. Perhaps pelletizing is claimed by the pyrometallurgist, but the work is generally done by the millman. The same general procedure is also applied to fine hematite flotation concentrate, making an excellent blast furnace feed. Perhaps in coming years we shall see a material increase in steel production without a corresponding increase in the number of blast furnaces because the production per furnace has been raised by using more pellets of high iron content and less crude ore of lower grade.

And a Look Ahead

What is the outlook for progress in mineral dressing in the immediate future? In the case of almost every

(Continued on page 140)

An electric shovel breaks up the sulphur contained in a storage vat at Port Sulphur, La. The conveyor belt feeds the loading facilities at the docks half a mile away

Sulphur

The year 1956 brought new records for production and consumption of sulphur in the United States. New projects promise further increases in production to meet the mounting demand for the yellow mineral. Exports remained high despite continually rising ocean freight costs and vessel shortages due to the Suez crisis

By JOHN C. CARRINGTON
Vice-President
Freeport Sulphur Co.

JOHN C. CARRINGTON graduated with a degree in engineering from Princeton University in 1933. He worked as a reporter for the Scripps-Howard newspaper group and in 1939 went with Freeport Sulphur Co. He was named assistant to the president in 1947 and elected a vice-president in 1952.

THIS was the third consecutive year in which domestic output and shipments have attained new highs over the preceding year, a condition attributable to the widespread use of sulphur and to the continued high level of the economy.

Production of sulphur from all sources in the U. S. was estimated, on the basis of preliminary data, at 7,875,000 long tons, or 825,000 tons more than in 1955. Most of this output was brimstone mined by the Frasch hot water process from salt dome deposits along the Gulf Coast of Louisiana and Texas. The remainder was sulphur or sulphur values recovered from numerous other sources.

The 13 Frasch process mines operating during the greater part of the year produced an estimated 6,450,000 tons of sulphur, an increase of 700,000 tons over the previous year. Texas Gulf Sulphur Co., the largest producer, operated three mines in Texas; Freeport Sulphur Co., four in Louisiana and one in Texas; Jefferson Lake Sulphur Co., two in Texas and one in Louisiana; and Duval Sulphur and Potash Co. and Standard Sulphur Co., one each in Texas. In November Freeport closed its small Nash Dome mine in Texas.

Of the balance of the supply, it was estimated that 500,000 tons represented sulphur recovered from gases, 425,000 tons sulphur contained in pyrites, and 500,000 tons sulphur in various forms from other sources. Gains were achieved in each instance: recovered sulphur was up 75,000 tons over the previous year, and pyrites and other sulphur were each up 25,000 tons.

Consumption Increases

Industry and agriculture consumed, on the basis of preliminary data, an estimated 5,900,000 tons of sulphur during the year, an increase of one quarter of a million tons.

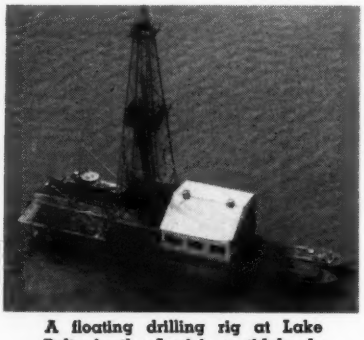
The pattern of use changed little from past years. Slightly more than four fifths of the sulphur consumed was converted into sulphuric acid and the rest was used in elemental form or in other chemical compounds. Fertilizers accounted for about 33 percent of the total; chemicals, 17½ percent; titanium and other pigments, 8 percent; pulp, 8 percent; iron and steel, 7 percent; and miscellaneous other uses,

including rayon and film, petroleum, chemicals, and those for ground and refined and carbon bisulphide, amounted to 26½ percent.

A portion of the supply consumed by the domestic industry—about 350,000 tons—was imported. Imports in the form of pyrites remained at 150,000 tons, the same as in 1955, and shipments of brimstone from the new Frasch mines of Mexico accounted for the remainder.

Meanwhile, exports of sulphur by U. S. producers held near the record levels of the past few years despite some speculation in the press that they would decline substantially. It is estimated that close to 1,600,000 tons of sulphur were sent abroad in 1956. This would about equal shipments made in 1955 and would be only 75,000 tons off the record established in 1954.

The year saw a continuation of the trend in the foreign markets towards



A floating drilling rig at Lake Pelto in the Louisiana tidelands

brimstone, as opposed to pyrites, as a source of sulphur. However, the problems encountered in making these deliveries were heightened during the year by the continually rising costs of ocean shipment, climaxed by the closing of the Suez Canal and the resultant premium on vessels. Freight rates soared as much as 50 percent for cargoes destined to the most heavily trafficked ports on the European continent and in the Far East.

As a result of the excess of production over shipments, Frasch producers appreciably strengthened their stockpile position.

No changes were registered during the year in the domestic price of Frasch sulphur which continued at $26.50 per long ton f.o.b. mine. Export prices were reduced in February from $31.00 per long ton f.o.b. Gulf ports to $28.00 by Freeport, and similar reductions were made later by other producers.

New Projects Under Way

Two new Frasch process mines were under development in 1956 and plans were announced to mine an additional new deposit.

Those being developed are the Lake Pelto property of Freeport and the Fannett dome of Texas Gulf. The former is located in the shallow waters of the Louisiana tidelands about 60 miles southwest of New Orleans, while the latter, on dry land, is near Beaumont, Texas.

TABLE I—SULPHUR IN THE UNITED STATES
(In thousands of long tons)

Production	1954	1955	1956 (estimated)
Brimstone			
Frasch process	5,500	5,750	6,450
Brimstone from gases	350	425	500
Other Sulphur			
Pyrites	400	400	425
Other forms and sources	400	475	500
Total	6,650	7,050	7,875
Consumption	5,050	5,650	5,900
Exports	1,650	1,600	1,600
Imports	125	184	350

The new deposit, known as Grand Isle—Block 18, lies off the coast of Louisiana beneath 45 ft of water six miles from the nearest land. The deposit, which is considered to be one of the most important sulphur discoveries of recent years, was discovered by Humble Oil and Refining Co. Upon approval by the Department of the Interior of the assignment of leases, Freeport will install and operate productive facilities. The Grand Isle project will be the first completely offshore sulphur mining operation ever undertaken.

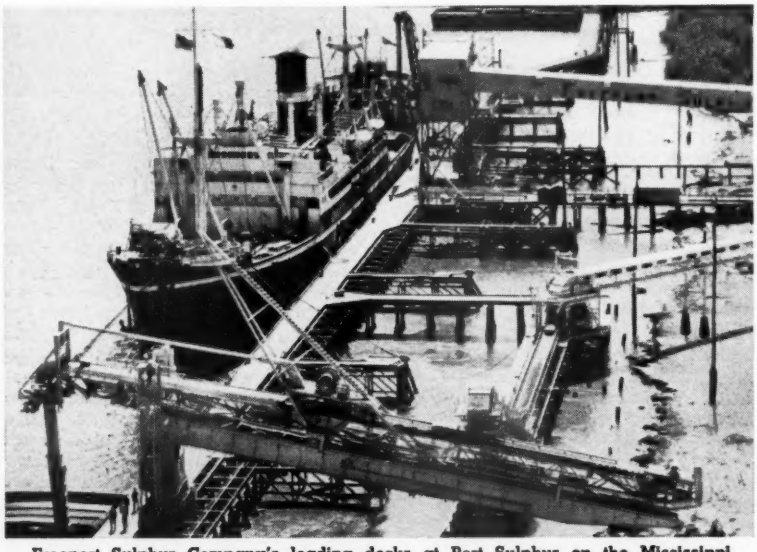
New sources of sulphur, other than Frasch process mines, which came on stream in this country during the year, contributed a total of about 300,000 tons of new annual productive capacity.

New projects using refinery gases as a source were reportedly completed by: Aurora Gasoline at Detroit, Mich.; Great Northern Oil, St. Paul, Minn.; Leonard Refining, Alma, Mich.; Montana Sulphur and Chemical, Billings, Mont.: and Tidewater Oil, Delaware City, Del. Four new projects recovering sulphur for sour natural gas are those of: J. L. Parker at Levelland, Texas; Signal Oil, Neiber Dome, Wyo.; Stanolind Oil & Gas, Odessa, Texas; and Phillips Chemical, Andrews County, Texas.

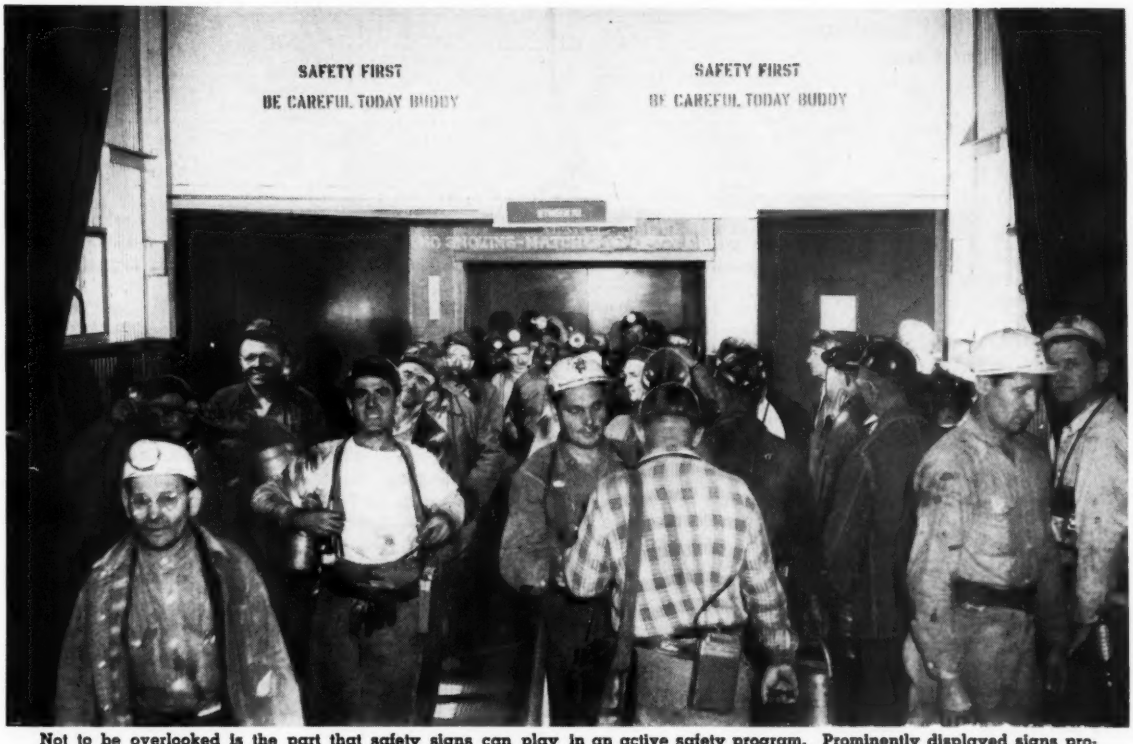
Expansion of existing facilities producing sulphur from refinery gases were made by Freeport at Westville, N. J.; Hancock Chemical at Wilmington and Long Beach, Calif.; Sinclair Refining, Marcus Hook, Pa.; and Union Oil at Wilmington and Santa Maria, Calif.

Mounting Demand

There is every indication that the upward trend in the free world's demand for sulphur is continuing. There is also evidence that Frasch process sulphur continues to hold a major place in world markets. The production record and the number of new projects scheduled for development by the Frasch industry should provide customers and potential customers an assured supply for the future.



Freeport Sulphur Company's loading docks at Port Sulphur on the Mississippi River—In the foreground is a new traveling loader placed in operation in 1956



Not to be overlooked is the part that safety signs can play in an active safety program. Prominently displayed signs provide daily reminders for the workmen to make safety a "must" on the job

Safety in Mining

Efforts are being made on all fronts to reduce mine accident rates. Some results are gratifying, others disappointing

By C. M. DONAHUE
Mine Safety Appliances Co.

FOR the second successive year the outstanding achievement of all safety programs has been the elimination of major mine disasters in coal mines in the United States. Although there were minor fires and explosions reported in which fewer than five men were killed, these too have received the attention of progressive companies and much effort is being devoted to their elimination. The rapid installation of fire-resistant cables and conveyor belts and the better rock dusting practices adopted will continue to reduce the hazards responsible far such calamities.

In addition to dry rock dusting, many companies have experienced good results in combating dust hazards through the use of a mixture of rock dust and water. Wet rock dusting is done during mining operations with no discomfort or interruption to miners working in face areas. The mixture is applied through a special wetting nozzle with conventional types of rock dust distributors or by applying a premixed slurry. Present observations indicate that wet rock dusting not only allows a more rapid mining rate but has safety advantages as well. More effective protection is obtained when dry dust is subsequently applied to wet dusted surfaces.

Coal Mine Fatality Rate Up

Preliminary information for 1956 on coal mine fatalities, as shown in the accompanying table, indicates an increase over 1955. Similarly, from data on non-fatal injuries for the first 9 months of 1956, it appears that there will be some improvement over the number of non-fatal injuries which occurred in 1955. The preliminary information for the first 11 months of 1956 shows a total of 416 fatalities in bituminous and anthracite mines, with a frequency rate of 1.10 per million man-hours of exposure.

In the first nine months of 1956 there were reported for all coal mines a total of 14,335 non-fatal injuries with a frequency of 47.29. From this it is reasonable to assume that the number of non-fatal injuries in 1956 will be about the same as for the previous year when 19,570 non-fatal injuries with a frequency of 48.82 were reported for the complete year.

Roof Falls Still Leading Accident Cause

Roof falls continued to lead as primary causes in fatal accidents as shown in a survey of 788 accidents in which 819 men were killed during the two-year period from October 1, 1954 through September 1956. Of these, 444 roof fall accidents account for 466 fatalities. During the same period, roof falls were the major factor in non-fatal injuries also. An analysis of these accidents shows that most of these occurred at the working faces due to inadequate roof support. In 1956 special emphasis was placed on the prevention of roof fall accidents in an effort to reduce this toll by continuing a national campaign which was instituted during 1955.

Roof bolting has been a major contribution in keeping roof fall accidents to a minimum and was adopted by more companies during the past year. As a supplement to the work already in progress, the United States Bureau of Mines is continuing experiments in the use of bonding materials which may reduce roof falls should these experiments prove successful.

Educational work has been stepped up by the United States Bureau of Mines, the various State Mining Departments and other organizations interested in this vital subject by directing the attention of all officials and employes to the seriousness of roof fall accidents. Special emphasis has been placed on training section foremen and face employes so they fully understand their duties and responsibilities to prevent roof falls.

The more general use of roof bolting brought with it the problem of eliminating dust from the roof drilling operation—now accomplished primarily by the use of dry dust collectors. This supplementary equipment contributes to the safety and health of the workers by preventing dustiness in the areas.

COAL MINE FATALITIES AND FREQUENCY RATES[1]
ALL FATALITIES

Period	Bituminous		Anthracite		Total	
	Fatals	Rate[2]	Fatals	Rate[2]	Fatals	Rate[2]
1952	449	0.90	99	1.03	548	0.92
1953	397	0.89	64	0.92	461	0.90
1954	334	0.99	62	1.23	396	1.02
1955	357	0.99	60	1.47	417	1.04
1956	389	1.06	55	1.26	444	1.08

[1] All data for 1954-1956 are subject to revision.
[2] Fatalities per million man-hours exposure.

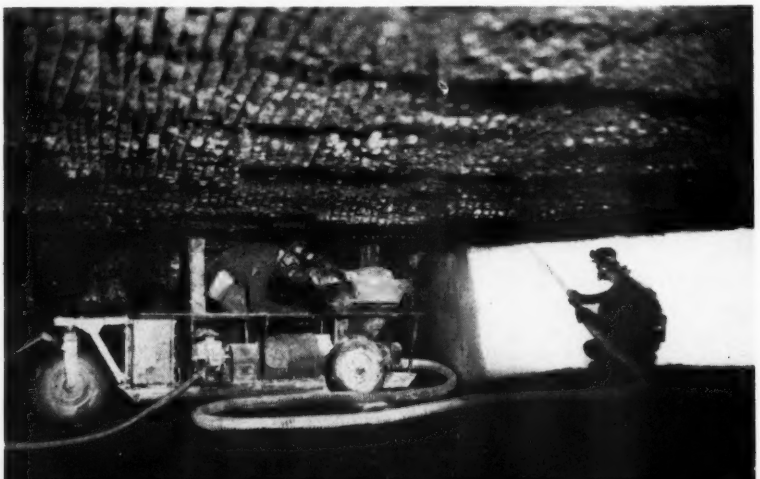
Haulage Maintains Second Place

Haulage accidents are next to roof fall accidents in importance and an analysis shows that physical hazards combined with unsafe practices are responsible for the majority of these. Effective underground traffic control is providing an assist in making transportation safer, particularly underground. Electronic systems of communication are rapidly becoming standard equipment on mine motors, officials' runabouts, man trips, etc. These systems provide effective underground traffic control and permit communication between moving units as well as communication with stationary units. In addition to speeding up transportation, this means of communication served to quickly report unsafe conditions such as faulty track, derailments, etc. before they became contributory causes of other accidents.

Although great strides have been made in the elimination of fire hazards, studies during the past year have shown that adequate fire fighting equipment is a good investment. Several companies, as a result of surveys, have acquired special fire-fighting equipment and among these which could be mentioned is a new, larger capacity truck specially designed with a pump which will develop a 450-ft head with a discharge rate of 100 gallons of water per minute.

U. S. Bureau of Mines personnel have determined that two of the most effective fire fighting mediums are water and rock dust, either alone or in combination, so that the addition of higher capacity fire trucks will supplement rock dust in case of fires as both are most commonly available in mines.

During the past decade the more extensive and efficient use of mining machinery has increased coal production with a decided decrease in the number of employes. Ten years ago roughly 50 percent of the coal tonnage was produced from mechanized mines. Today, it is estimated that better than 80 percent of the production is from such mines. Manufacturers are doing everything possible to insure safety in the design and operation of their equipment, but continued training in employe safety is a requisite for reduction in injuries. Changes in mining methods, job analyses of various operations, preventive maintenance, and the installation of newer types of equipment are helping to establish more favorable safety records with corresponding increases in productivity.



Rock dust, to be most effective, has to be kept up to the face

Mine Area Lighting Promises Help

In January 1956, the U. S. Bureau of Mines published Schedule No. 29 "Mine Lighting Equipment for Illuminating Underground Workings" under which two permissible mine lighting systems were approved in November. This is the most significant change in mine lighting since the introduction of approved electric cap lamps. The systems as approved by the U. S. Bureau of Mines consist of fluorescent fixtures, cables, cable connectors, and distribution panel which includes circuit breakers for protecting each circuit against overloads and short circuits. One is an ungrounded isolated two-pole system requiring two-conductor cable, and the second covers a grounded three-pole system which requires three-conductor cable.

The original experimental work on this type of lighting started in 1953 by the Mining Development Committee of the Bituminous Coal Research,

COAL MINE NON-FATAL INJURIES AND FREQUENCY RATES[1]

Period	Bituminous Non-fatal	Bituminous Rate[2]	Anthracite Non-fatal	Anthracite Rate[2]	Total Non-fatal	Total Rate[2]
1952	23,719	47.64	6,355	66.35	30,074	50.66
1953	20,112	45.26	4,146	59.85	24,258	47.23
1954	14,746	43.66	2,972	59.18	17,718	45.67
1955	16,540	45.94	3,030	74.21	19,570	48.82
1956 (Jan.-Sept.)	11,865	43.66	2,470	78.71	14,335	47.29

[1] All data for 1954-1956 are subject to revision.
[2] Per million man-hours exposure.

Inc. in cooperation with several mining companies and manufacturers, State Mining Departments, and the U. S. Bureau of Mines. The major problem was to determine if a permissible lighting fixture could be successfully used with mining equipment in normal coal production. Experience with experimental equipment showed definitely that the objectives could be attained, after which further development work produced the systems as now approved. Experience where the experimental systems were installed prompted the observation that an area lighting system such as has been approved has many advantages. There were fewer accidents, production was higher, and better morale was evident with this type of lighting supplementing electric cap lamps.

Metal Mine Accidents Show Steady Decrease

In metal mining there has been a consistent decrease in all accidents which is attributed to greater emphasis on all phases of safety, including training in safe work practices, accident prevention, first aid and mine rescue. A detailed analysis of several hundred accidents in underground iron ore mines shows that falls of ground, as in coal mines, were the major cause of injuries. Of 346 accidents analyzed, the observation is made that 74.2 percent were caused by unsafe practices and it is in this field particularly where safety training will show positive results. The National Safety Council reports that there was a reduction of 29 percent in accidents from falls of ground in 1956 over 1955.

Even with all the newer types of equipment made available in advancing the art of mining, it is of greatest importance that safety training of employes and officials must be continued on an all-year-round basis. Training in mine rescue and first aid was continued during the past year by more companies who considered this a nucleus for their mine safety programs. There was evidence this past year that more segments of the industry recognized that safety contributed to gains in productivity. Continued cooperation and training will insure that manpower and mining machinery are utilized to the fullest extent in achieving peak production with safety.

Molybdenum

Industry continued growth in 1956 to keep production in near-perfect balance with demand

CONSUMPTION of molybdenum in the free world continued to grow in 1956, reaching an estimated total of 61,500,000 lb. This compares with approximately 56,000,000 lb in 1955 and 41,000,000 lbs during the comparatively slack period of 1954. Production during the year was almost perfectly balanced with demand. That no molybdenum consumers suffered from shortages is a tribute to the remarkable success of the producers in establishing a realistic distribution system.

U. S. Largest Producer, User

The United States, with its thriving iron and steel industry and the increasing attention its chemical industry is paying to moly, was again by far the largest molybdenum consumer. Consumption estimates for the U. S. for 1956 are upwards of 38,000,000 lb. Other principal users were Britain with consumption estimated at about 7,000,000 lb; Germany at about 6,300,000 lb and France at about 3,300,000 lb. Other important consumers included Sweden, Canada, Italy, Japan and Austria. Supply and consumption of molybdenum behind the Iron Curtain are not generally known. However, the American Government, American producers and European consumers continued cooperative efforts to prevent free world molybdenum from entering Communist dominated areas.

The United States continued during 1956 to be by far the major producer of molybdenum. Estimates place 1956 production outside the U. S. at less than 5,000,000 lb. The nation's big primary producer, Climax Molybdenum Co., and the various mining companies producing molybdenum as a byproduct of U. S. copper ores combined to turn out slightly less than 57,000,000 lb according to present estimates. Those estimates also indicate that the mine at Climax, Colo., produced somewhat more than 60 percent of total free world output.

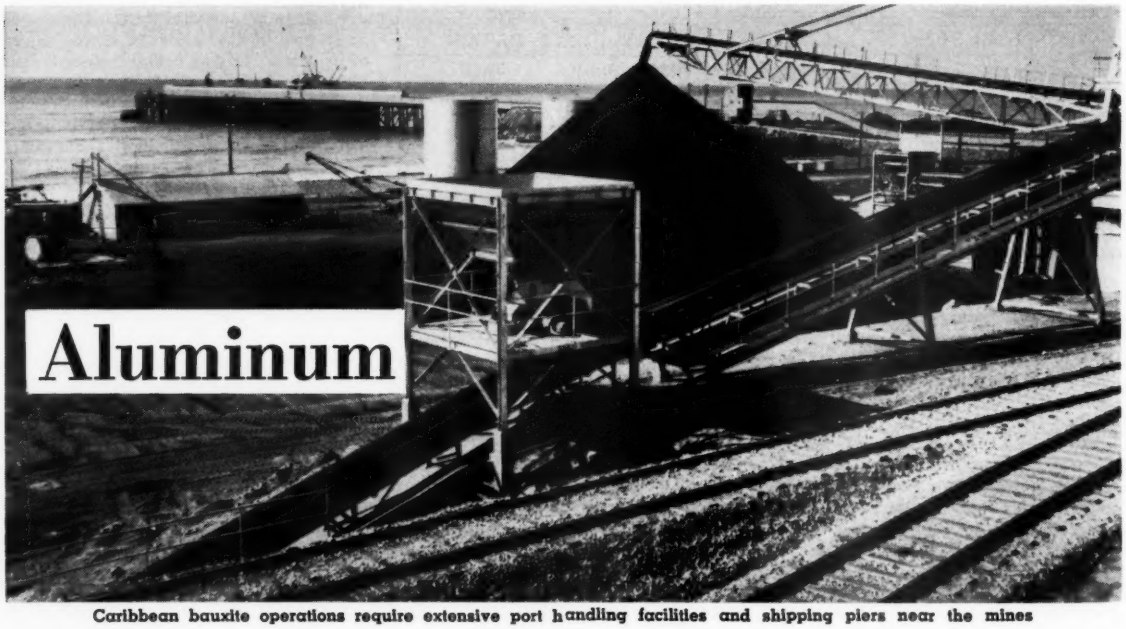
Expanding Markets

As would be expected, there were no sensational new molybdenum uses during the year. However, growth trends established during the past few years continued and there was a noticeable increase in the use of molybdenum in the various high temperature and high alloy materials for aircraft and general industrial applications. Most promising gains in non-metallurgical applications probably were the growing acceptance of molybdenum-cobalt catalysts for petroleum desulfurization, increased use of moly-oxide as a trace element for agriculture, and widening applications of molysulfide as a lubricant. While European consumption gains were most notable in the stainless steels used by the chemical and paper industries, there were marked increases in other metallurgical uses.

Production to be Increased

World consumption of molybdenum for 1957, like all other world forecasts, is still clouded by the Suez situation. Before these disruptions, molybdenum producers expected growth trends on a world basis to continue at a fairly constant rate.

It is understood that Climax Molybdenum Co. is completing a program which will permit a modest increase in production during 1957. These improvements at Climax, plus the possibility of expanding supplies from by-product production, make producers confident of coping with any increased demands in the immediate future.

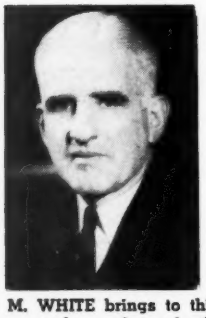


Caribbean bauxite operations require extensive port handling facilities and shipping piers near the mines

Aluminum

With the abatement of Government stockpile demands, and with new capacity scheduled for completion in 1957, the aluminum industry looks forward to supplies sufficient to fill our ever-expanding civilian demands and to allow for development of many new uses for the lightweight metal

By DONALD M. WHITE
Secretary
The Aluminum Association



DONALD M. WHITE brings to this review fourteen years of experience in the aluminum industry. A graduate of Princeton University, he spent 17 years in the banking and brokerage business before joining the staff of The Aluminum Association in 1943. Since 1945 he has served that organization as Secretary-Treasurer, a position which gives him the broadest possible view of his industry's fast rise to prominence.

FOR the aluminum industry the year 1956 was one in which its continuing program of expansion brought the supply of its products up to the level of demand. As a result, the industry is now giving renewed attention to many new uses for the lightweight metal.

For the fifth year in a row the industry has set a new record in primary aluminum production. Despite losses due to strikes during the early part of the third quarter, total U. S. primary aluminum output in 1956 is estimated at 3,565,000,000 pounds based on statistics for 11 months. This is about 7.5 percent over the 1955 record.

Output of All Classes of Aluminum Products Higher

Elimination of stockpile calls eased the aluminum supply situation considerably during the year. By the end of 1956 the Office of Defense Mobilization had reduced its acquisition of the metal by a total of 1,300,000,000 pounds. With minimum aluminum stockpiling objectives attained, the ODM has announced that there will be no stockpile call for the metal in the first half of 1957, thereby making the total supply available to industry.

Shipments of almost all classes of semifabricated aluminum products were at higher levels in 1956 than in the previous year. Statistics compiled by the U. S. Bureau of the Census show an 8.1 percent increase in total shipments of wrought products during the first nine months of the year compared with the same months of 1955. The Bureau's figures show shipments of sheet and plate up 9.4 percent; extruded shapes up 6.2 percent; rolled structural shapes, rod and bar up 12.3 percent; and forgings up 8.1 percent. Marked increases have been registered in shipments of aluminum wire and cable for electrical use, the nine-month totals showing ACSR (aluminum cable, steel reinforced) and bare cable up 21.3 percent, bare wire up 77.4 percent and insulated wire and cable up 49 percent over the corresponding months of 1955. These figures reflect an increasing realization of the economic advantages of aluminum as an electric conductor. Shipments of aluminum foil in 1956 were off slightly from the record-breaking level of 1955. Aluminum-casting shipments were at about their 1955 levels.

Secondary Ingot Production High

Production of aluminum ingot from scrap continued at a high level in 1956. Figures compiled by the U. S. Bureau of Mines showed the production during the first half of the year about two percent over the same period of 1955. Since much of the secondary-ingot output goes to foundries, which are large suppliers to automotive manufacturers, the production of secondary ingot in the latter part of the year showed a substantial increase as full production of 1957 automobiles got under way.

Following another round of wage increases to aluminum industry workers, modest increases in the prices of aluminum and its products became necessary. These brought the price of basic aluminum pig to 25 cents per pound.

Primary aluminum producers increased their annual capacity by more than a quarter of a billion pounds in 1956 so that by year-end their total capacity was 3,524,000,000 pounds per year. Additional facilities now under construction will increase the industry's primary capacity by about 42 percent during the next two years. Included are four new reduction plants, two of which are being built by new producers who have been fabricating aluminum for many years. Their entry will bring the total number of primary aluminum producers in the United States to six.

Power from Coal

One of the most significant developments in the current primary aluminum expansion is the industry's use of coal for producing the large amounts of electric energy required. Three of the four new reduction plants will obtain their electricity from coal-fired steam power plants. They are being built near bituminous coal mines in the Ohio River Valley so as to keep coal handling and transportation costs at a minimum.

Before 1940 the aluminum industry obtained all the power it needed for primary production from hydroelectric sources, building its reduction plants in areas where large amounts of hydro power were available. After World War II, however, demand for the metal increased to such levels that the industry had to seek other sources of power. Some of the reduction plants built in recent years thus obtain their power from natural gas, being located in the South where large supplies of this fuel are available. One Southern plant was built near large deposits of lignite so as to obtain its power supply from that fuel.

As its continuing expansion brought the need for more and more power, the industry naturally turned to coal, for an estimated 95 percent of the nation's coal reserves are still to be mined. Furthermore, recent advances in mining and handling methods have made coal increasingly attractive economically, especially for plants near the mines. The impending large-scale use of coal as a source of electricity for primary aluminum production is regarded as a development of great significance to the continued growth of the aluminum industry and one that will result in a considerable expansion of the bituminous coal industry.

Jamaica Leads in Bauxite Production

Record production of primary aluminum of course requires the mining of bauxite at record levels. Statistics from the U. S. Bureau of Mines for the first half of 1956 show bauxite imports up 21 percent over the first half of 1955, with 49 percent coming from the Island of Jamaica, 46 percent from Surinam and most of the remainder from British Guiana. Domestic bauxite mining, however, was two percent under its level in the first half of 1955. One company began mining bauxite in Haiti during the second half of the year, and substantial shipments of ore are expected from there in 1957 when facilities now under construction are completed. Another has started building new mining facilities in the Dominican Republic.

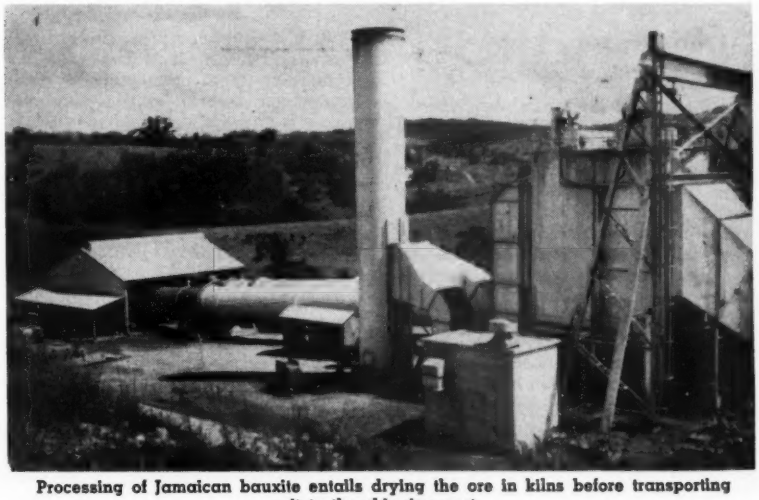
Three new alumina or bauxite-refining plants are now being built in the United States; when completed, these will add 1,350,000 tons to the nation's annual alumina capacity. One of the new primary producers has contracted with two Japanese companies for a total annual supply of 105,000 tons of alumina for its new reduction plant. Deliveries are scheduled to start in August 1957. This will mark the first use of alumina from a foreign source for commercial aluminum production in this country.

Extraction of alumina from clay, long a dream of the aluminum industry, came a step nearer to commercial reality during 1956 when one producer announced plans for the construction of a $1,000,000 pilot plant to produce 50 tons of alumina per day from Idaho clay. Progress of this development will be watched with great interest.

Facilities for fabricating all types of aluminum products were expanded substantially during 1956. All of the large fabricators expanded their plants and some built new plants in new locations. The year also saw many new aluminum fabricators in the field. As a result of all this expansion, the aluminum industry is now more widely distributed geographically than ever before, most of the new facilities being built in areas where the markets for aluminum products are the largest.

Market Breakdown

Building materials continued to lead the list of civilian end uses of aluminum in 1956 as they have every year since World War II. Statistics compiled by The Aluminum Association show that these uses accounted for 19.0 percent of wrought aluminum products shipped during the first half of the year; transportation equipment accounted for 17.4 percent and consumer durable goods 13.0 percent. These three classes of application together thus accounted for about half of the total wrought aluminum shipments. Other major uses of wrought products included: electrical 7.8 percent; commercial and industrial machinery and equipment (except electrical) 6.2 percent; packaging and containers 4.4 percent. The Aluminum Association statistics also show that 16.7 percent of all wrought products shipped during the first half of the year went to distributors and jobbers. Transportation equipment continues



Processing of Jamaican bauxite entails drying the ore in kilns before transporting it to the shipping port

as the biggest user of aluminum castings, with smaller proportions of the total casting output going into industrial and commercial machines, equipment and tools, and into home appliances, furnishings and equipment.

Use of aluminum in automobiles increased to an average of about 35 pounds per car in 1956, according to recent surveys. Some makes averaged as high as 75 pounds per car and one model contained almost 200 pounds of the lightweight metal. Biggest uses of aluminum in automobiles continue to be in engine parts, automatic transmissions and trim. An experimental engine with a die-cast cylinder block may be the forerunner of much greater aluminum use in automobile engines. The improved aluminum supply situation is expected to stimulate many new uses of the metal by the automotive industry.

The year 1956 saw increasing quantities of aluminum used in refrigerators and freezers, both home and commercial types. Use of the metal in this field is expected to advance still further as more manufacturers realize its advantages of efficient cooling and high resistance to corrosion, which are particularly important in these units.

A conveyor moves imported bauxite from an unloading pier to an alumina plant

More aluminum furniture was seen in 1956 than in previous years. The trend toward lightweight units and trim modern design are among recent developments favoring increased use of aluminum in this field. The marked increase in outdoor living also is a factor, as aluminum's resistance to weather is unmatched among furniture materials.

Possibility of wide use of aluminum in cans for the food-packing industries advanced apace during 1956 with the development of improved methods of plating aluminum on steel.

These are some of the most notable developments during another big year for the aluminum industry. With the new capacity scheduled for completion in 1957, industry leaders are predicting total shipments of over four billion pounds of aluminum products during the new year. With supply now meeting demand, the industry regards 1957 as a year in which new uses for the lightweight metal will hold the spotlight.

Iron Ore

(Continued from page 75)

and jaspers in Michigan and Wisconsin, such as the Groveland area of M. A. Hanna and Ashland County, Wisconsin, where several companies have reported sizable tonnages. These properties aim to supply very high-grade pellets to the industry in the future. Research work has continued on the non-magnetic taconites, particularly from the Mesabi and Marquette Ranges, which may also contribute additional future production.

There is also continued exploration and investigation of iron-bearing areas in all parts of the United States, mainly looking for the higher-grade materials which can be produced from the long-known iron-bearing areas. Under active development is the Grace Mine of Bethlehem Steel Co., which is scheduled to produce 1,500,000 tons per year of high-grade, concentrated, agglomerated product starting in 1958.

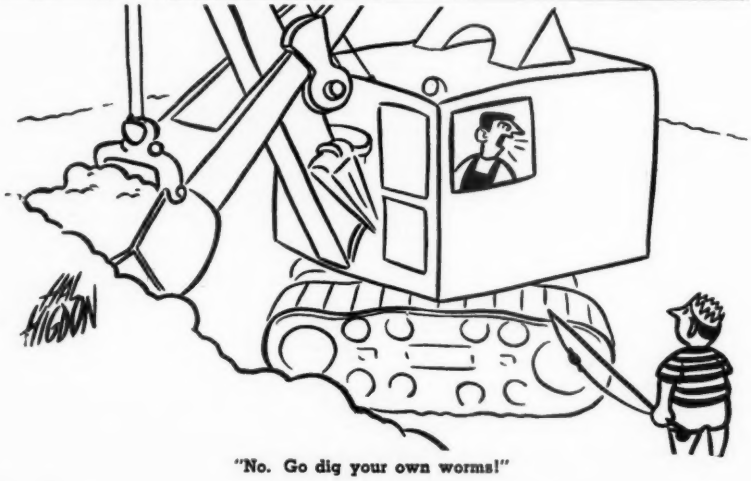
Canadian Developments

In Canada, there were announcements of two new properties, both scheduled to produce high-grade, concentrated, agglomerated products, one being the Hilton Mine located near Ottawa and operated by Pickands Mather & Co., which is now under construction and scheduled for 600,000 tons per year starting in 1957, and the other being the Moose Mountain Mine in Ontario, operated by M. A. Hanna Co. and scheduled for 500,000 tons per year starting in 1958.

In Quebec-Labrador, there was announcement during the year of the contemplated development of Canadian Javelin's concentrating iron ore located in the southern end of the Labrador trough. It is indicated that production from this source could amount to several million tons per year of a very high-grade product. Announcements were also made of discoveries of concentrating material in many places in Ontario, particularly north of Lake Superior, and of substantial tonnages of iron formation indicated on the Belcher Islands in Hudson Bay.

Perhaps of greatest importance are the many announcements of increased ore possibilities from the Quebec-Labrador area, where the giant band of iron formation extends almost continuously for some 700 miles. Sizable tonnages of concentrating magnetite ore are reported at the north end of the Labrador trough by the Cyrus Eaton interests, Oceanic Ore and Fenimore Mines. Then, south and southwest of the present producing areas, considerable new tonnages have been reported by the United States Steel Corporation and Canadian Javelin.

Active exploration work is also under way on a large scale by the Hollinger-Hanna interests in the southern part of their present holdings in concentrating ore areas, and many exploration projects continued in this general area by others. It begins to appear as though the available iron units in the Quebec-Labrador trough could far exceed the great Lake Superior district of the United States. As there are substantially no direct shipping ores being encountered in any of these new areas, only improved concentrating methods and over-all economies will determine how many of these iron units can be considered as usable reserves.



"No. Go dig your own worms!"

PHOTO COURTESY GOODMAN MANUFACTURING COMPANY

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Conventional mobile loading machines still handle the lion's share of mechanically loaded coal

Sales of Coal-Mine Equipment

1956 saw gains in equipment sales as well as in coal production

By W. H. YOUNG and R. L. ANDERSON

Respectively, Chief, Bituminous Coal and Lignite Section, and Supervisory Commodity-Industry Analyst, U. S. Bureau of Mines

As the Nation's coal mining statisticians, W. H. YOUNG and R. L. ANDERSON, are looked to by industry for the official facts and figures to show coal's progress over the years.

Dr. Young joined the U. S. Bureau of Mines as an economist in the Coal Economics Division. Since 1944 he has served as chief of the Bituminous Coal Section of that division.

After working with a firm of consulting engineers, R. L. Anderson joined the Government in 1934. Since that time he has been employed by various agencies having to do with coal and at the present time is a commodity-industry analyst with the Bureau.

SHIPMENTS of mechanical loading equipment for underground use in coal mines in the United States, in terms of capacity, were 44 percent larger in 1956 than in 1955. The capacity of mechanical cleaning equipment sold for use at bituminous-coal mines was six percent less in 1956 than in 1955. Shipments of coal recovery augers, shuttle cars, and "mother" conveyors for use in coal mines in the United States increased in 1956 from 1955. Bridge conveyor shipments in 1956 are listed separately for the first time.

This survey was made possible by the cooperation of all known manufacturers of mechanical cleaning equipment for bituminous-coal mines and of mechanical loading and supplementary haulage equipment and coal-recovery augers for use in all coal mines in the United States. Data from various trade journals were also utilized.

Mechanical loading units, coal recovery augers, and supplementary haulage equipment sales in 1956, as in previous years, represent shipments made during the year. Of the total capacity of mechanical cleaning equipment sold in 1956, 34 percent was placed in operation during that year; the remainder (66 percent) will be installed later.

Mechanical Loading and Mining

Estimated bituminous coal and lignite mechanically loaded in underground mines increased from 302,000,000 tons in 1955 to 315,000,000 tons in 1956, or four percent. Estimated production at strip mines increased from 110,000,000 tons to 124,000,000 tons, or 13 percent, and auger mine production increased from 6,000,000 to 7,000,000 tons during the same period.

Table I shows data on bituminous-coal and lignite production, by methods of mining, and mechanical cleaning for 1954-56, inclusive. The percentage of total output mechanically loaded and cleaned continues to increase. During 1956, approximately 89 percent of the total output was mechanically loaded at underground mines, loaded by power shovels at

With the advent of extensible belts transfer conveyor sales have spurted

strip mines, or mined by augers along highwalls in strip mines.

Underground production of bituminous coal and lignite, by methods of loading is listed in table II. Preliminary figures for 1956 show little change from the previous year in the percentage of the underground output that was loaded mechanically.

Auger Mining. The use of augers for coal recovery along highwalls in strip mines was begun about 1945, but separate data on the number of augers in use and the tonnage produced by auger mining were first collected for 1952.

Reports from four manufacturers of coal-recovery augers show that 89 augers were shipped in 1956 compared with 66 in 1955, an increase of 35 percent. All augers shipped in 1956 were for use along highwalls at strip mines. Table III shows coal recovery auger shipments in 1953, 1954, 1955, and 1956, and table V, the number in use

TABLE I—BITUMINOUS-COAL AND LIGNITE PRODUCTION, BY METHODS OF MINING AND BY MECHANICAL CLEANING, IN THE UNITED STATES, 1954-56, INCLUSIVE

	1954		1955[1]		1956[1]	
	Thousand net tons	% of total	Thousand net tons	% of total	Thousand net tons	% of total
Hand-loaded underground	46,377	11.8	52,000	11.1	54,000	10.8
Mechanically loaded underground	242,735	62.0	302,000	64.2	315,000	63.0
Mined at auger mines	4,460	1.1	6,000	1.3	7,000	1.4
Mined by stripping	98,134	25.1	110,000	23.4	124,000	24.8
Total production	391,706	100.0	470,000	100.0	500,000	100.0
Mechanically cleaned	232,764	59.4	282,000	60.0	305,000	61.0

[1] Preliminary.

TABLE II—UNDERGROUND BITUMINOUS-COAL AND LIGNITE PRODUCTION, BY METHODS OF LOADING, 1954-56, INCLUSIVE

	1954		1955[1]		1956[1]	
	Thousand net tons	% of total	Thousand net tons	% of total	Thousand net tons	% of total
Mobile loading machines:						
Loading directly into mine cars	41,585	14.4	(2)	(2)	(2)	(2)
Loading onto conveyors	11,318	3.9	(2)	(2)	(2)	(2)
Loading into shuttle cars	153,463	53.1	(2)	(2)	(2)	(2)
Continuous mining machines	16,336	5.7	(2)	(2)	(2)	(2)
Scrapers	417	0.1	(2)	(2)	(2)	(2)
Conveyors equipped with duckbills or other self-loading heads	4,347	1.5	(2)	(2)	(2)	(2)
Hand-loaded conveyors	15,269	5.3	(2)	(2)	(2)	(2)
Total mechanically loaded	242,735	84.0	302,000	85.3	315,000	85.4
Hand-loaded into mine cars	46,377	16.0	52,000	14.7	54,000	14.6
Total underground production	289,112	100.0	354,000	100.0	369,000	100.0

[1] Preliminary.
[2] Included with "Total mechanically loaded."

TABLE III—UNITS OF MECHANICAL LOADING AND MINING EQUIPMENT SOLD FOR USE IN COAL MINES, AS REPORTED BY MANUFACTURERS, 1951-56, INCLUSIVE

Type of equipment	1951	1952	1953	1954	1955	1956	Change from 1955 (percent)
Bituminous-coal and lignite mines:							
Mobile loading machines	287	206	180	92	120	254	+111.7
Continuous mining machines			67	101	109	154	+ 41.3
Coal-recovery augers	(1)	(1)	57	55	65	89	+ 36.9
Scrapers[2]	4	8	11	5	...	...	...
Shuttle cars	524	428	437	242	348	536	+ 54.0
"Mother" conveyors[3]	114	67	58	19	78	137	+ 75.6
Room or transfer conveyors[4]	297	155	87	61	143	232	+ 62.2
Bridge conveyors	(5)	(5)	(5)	(5)	(5)	128	(5)
Anthracite mines (Pennsylvania):							
Mobile loading machines	...	...	1	17	1	1	...
Continuous mining machines	...	...	...	1	...	...	...
Coal-recovery augers	(1)	(1)	...	...	1	...	—100.0
Scrapers[2]	8	5	3	...	2	...	—100.0
Shuttle cars	...	...	...	14	8	2	— 75.0
"Mother" conveyors[3]	...	...	...	...	3	...	—100.0
Room or transfer conveyors[4]	34	34	16	24	7	19	+171.4
Number of manufacturers reporting	21	22	25	23	22	22	...

[1] Not available. Total number of coal-recovery augers sold 1946-52, inclusive, was 271.
[2] Reported as scrapers or scraper haulers and hoists.
[3] Includes all haulage conveyors with a capacity over 500 ft, except main slope conveyors.
[4] Includes all haulage conveyors with a capacity of 100 ft to 500 ft, except main slope conveyors.
[5] Not available.

TABLE IV—SALES OF MECHANICAL LOADING EQUIPMENT IN 1955 AND 1956 COMPARED WITH MACHINES IN USE IN PRECEDING YEARS.

	Number of machines in use, as reported by mine operators						Number of machines sold as reported by manufacturers	
	1949	1950	1951	1952	1953	1954	1955	1956
Bituminous-coal and lignite mines:								
Mobile loading machines	4,205	4,318	4,410	4,083	3,985	4,292	120	254
Continuous mining machines				152	219	320	109	154
Scrapers	46	39	22	19	29	47	...	...
Conveyors equipped with duckbills or other self-loading heads	1,483	1,329	1,242	1,049	849	618	(1)	(1)
Hand-loaded room conveyors, number of units	4,312	4,434	3,904	3,569	2,994	2,205	143[1]	232[1]
Anthracite mines (Pennsylvania):								
Mobile loading machines	27	30	43	54	39	68	1	1
Continuous mining machines	...	...	...	...	...	...	...	...
Scrapers	589	556	528	456	489	359	2	...
Hand-loaded room conveyors, number of units[2]	3,618	3,460	3,282	3,232	2,784	2,277	7	19

[1] Sales of conveyors equipped with duckbills or other self-loading heads are included with hand-loaded room conveyors.
[2] Includes pit-car loaders and conveyors equipped with duckbills or other self-loading heads.

in 1954 and shipments in 1955-56 by States.

Types of units sold. Table III lists the units of mechanical loading and mining equipment shipped for use at coal mines in the United States, 1951-56 inclusive. Shipments of all types of mechanical loading equipment except scraper loaders increased in 1956 over 1955. Shipments of shuttle cars, "mother" conveyors and room or transfer conveyors also increased in 1956 over 1955.

Exports of underground mechanical-loading equipment in 1956, in terms of capacity, amounted to 14 percent of the shipments to mines in the United States compared with nine percent in 1955.

Types of mechanical-loading equipment sold compared with units in use. Table IV shows the trend in demand for various types of mechanical-loading equipment. Mobile loading machines in use reached the maximum in 1951 at bituminous-coal and lignite mines and in 1954 at Pennsylvania anthracite mines. Shipments of mobile loading machines in 1956 amounted to six percent of the number in use in 1954 at both bituminous-coal and lignite mines and Pennsylvania anthracite mines.

Table V shows the number of mechanical loading units and coal-recovery augers shipped to various States in 1955 and 1956 compared with the number in use in 1954, as reported by mine operators. Sales of room conveyors as listed in table V are not exactly comparable with the number of room conveyors in use. To avoid duplication in tonnage mechanically loaded, each mine operator was instructed to report "hand-loaded" and "self-loading" conveyor tonnage only; therefore, room conveyors loaded by mobile loaders are not included with "room conveyors in use in 1953." Shipments of coal recovery augers in

TABLE V—MECHANICAL LOADING AND MINING EQUIPMENT IN USE IN 1954, BY STATES, COMPARED WITH SALES REPORTED IN 1955-56

	Mobile loading machines			Continuous mining machines			Scrapers[1]	Room conveyors[2]			Coal-recovery augers		
	In use	Sales		In use	Sales		In use	In use	Sales		In use	Sales	
	1954	1955	1956	1954	1955	1956	1954	1954	1955	1956	1954	1955	1956
Bituminous-coal and lignite mines:													
Alabama	136	2	22	10	...	1	...	118	4	6	...	..	..
Alaska	11	...	...	2	...	...	14	...	...	...	...	..	..
Arkansas	...	...	...	...	...	...	...	38	...	...	...	..	..
Colorado	57	...	1	4	...	...	2	174	...	...	...	1	...
Illinois	272	1	1	22	7	9	...	15	...	...	...	1	2
Indiana	89	1	3	4	...	1	...	...	...	...	...	..	..
Iowa	5	...	...	...	...	...	...	1	...	...	...	..	..
Kentucky	585	27	33	14	6	5	...	315	28	32	17	11	15
Maryland	2	...	...	...	...	...	...	8	...	...	...	..	..
Montana, bituminous	17	...	...	...	...	...	...	11	...	...	...	..	..
New Mexico	16	...	...	...	...	...	...	1	...	...	...	..	..
North Dakota and Montana, lignite	3	...	...	...	...	...	...	...	...	...	...	..	..
Ohio	173	...	3	12	4	8	1	58	7	5	32	5	12
Oklahoma	7	...	...	...	...	...	...	117	...	5	...	..	..
Pennsylvania	964	17	48	153	50	68	11	643	12	30	25	8	10
Tennessee	31	3	...	...	...	1	...	39	...	...	5	..	2
Utah	146	3	3	6	5	2	...	40	...	...	...	..	..
Virginia	168	14	15	5	9	3	1	105	17	6	8	6	7
Washington	4	...	...	7	1	...	11	84	...	...	...	..	..
West Virginia	1,565	52	124	79	27	56	3	868	75	148	90	33	41
Wyoming	41	...	1	2	...	...	4	188	...	...	...	..	..
Total bituminous coal and lignite	4,292	120	254	320	109	154	47	2,823	143	232	177	65	89
Anthracite mines (Pennsylvania)	68	1	1	...	...	...	359	2,277[3]	7	19	...	1	..
Grand total	4,360	121	255	320	109	154	406	5,100	150	251	177	66	89

[1] Sales of 2 scrapers were made to Pennsylvania anthracite mines in 1955 and no scraper sales were reported in 1956.
[2] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.
[3] Also includes pit-car loaders.

1955 and 1956 combined were 88 percent of the total number in use in 1954.

Haulage Equipment

Shuttle cars. Sales of shuttle cars increased from 356 in 1955 to 538 in 1956. Details of shipments to various States in 1955 and 1956 are given in table VI.

Exports of shuttle cars in 1956 were more than double those of the previous year. Units exported amounted to approximately 15 percent of the 1956 sales in the United States.

"Mother" conveyors. For the purpose of this study a "mother" conveyor is defined as a sectional, extensible, power-driven conveying unit that can handle over 500 ft of conveyor. Mainslope conveyors are excluded. Table III lists sales for 1951-56, inclusive, and table VI shows shipments by States in 1955 and 1956. Exports of "mother" conveyors in 1956 were two percent of the sales in the United States.

Bridge conveyors. Sales of bridge conveyors were first reported in 1950 and they have been included with face conveyors in previous reviews. During recent years, however, the sales of face conveyors have been decreasing while sales of bridge conveyors have been increasing so the two have been separated. In 1956 there were 15 face conveyors sold and 128 bridge conveyors. Bridge conveyor shipments by States are listed on table VI and face conveyor shipments by States are not included.

Bridge conveyor shipments were reported separately for the first time

TABLE VI—UNITS OF CONVEYING EQUIPMENT SOLD FOR USE IN COAL MINES, 1955-56, BY STATES

State	Bridge conveyors[1] 1956	Shuttle cars 1955	Shuttle cars 1956	"Mother" conveyors[2] 1955	"Mother" conveyors[2] 1956
Bituminous-coal and lignite mines:					
Alabama	6	17	47	3	7
Colorado	...	2	4	...	1
Illinois	4	12	11	1	12
Indiana	...	3	8	1	1
Kentucky	30	45	32	8	6
Ohio	10	...	9	7	9
Oklahoma	...	...	2	...	...
Pennsylvania	12	96	130	27	36
Tennessee	...	2	4	...	1
Utah	...	13	8	2	4
Virginia	3	31	40	6	7
West Virginia	63	127	239	23	53
Wyoming	...	...	2	...	...
Total bituminous coal and lignite	128	348	536	78	137
Anthracite mines (Pennsylvania)	...	8	2	3	...
Grand total	128	356	538	81	137

[1] Data not available for 1955.
[2] Includes all haulage conveyors with capacity over 500 ft, except main slope conveyors.

TABLE VII—BITUMINOUS COAL MECHANICALLY CLEANED IN 1954 COMPARED WITH SALES OF MECHANICAL CLEANING EQUIPMENT IN 1955-56, BY STATES

State	Number of plants in operation	1954 Net tons of cleaned coal	Output mechanically cleaned (percent)	Annual capacity of equipment sold (net tons)[1] 1955	Annual capacity of equipment sold (net tons)[1] 1956
Alabama	49	9,173,047	89.2	[2]	398,000
Alaska	2	221,453	33.2	...	...
Arkansas	...	[3]	[4]	...	...
Colorado	4	1,073,254[3]	31.8[3]	...	...
Illinois	66	35,116,921	83.7	2,757,000	1,953,000
Indiana	25	10,762,266	80.3	...	[2]
Kansas	5	1,229,962	89.6	...	...
Kentucky	82	32,878,696	57.7	4,739,000	4,215,000
Missouri	8	2,299,225	91.5	...	...
Montana	3	12,757	0.9	...	...
New Mexico	1	73,272	59.5	...	...
Ohio	24	13,443,275	41.4	...	[2]
Oklahoma	4	685,426	35.8	...	...
Pennsylvania	96	44,214,865	61.4	1,109,000	1,894,000
Tennessee	7	472,119	7.3	...	...
Utah	4	2,073,706	41.4	...	[2]
Virginia	29	8,460,496	51.6	1,413,000	[2]
Washington	10	592,612	95.7	[2]	...
West Virginia	193	69,969,941	60.3	8,294,000	7,419,000
Wyoming	1	10,730	0.4	...	...
Undistributed	...	...	...	843,000	2,059,000
Total	613	232,764,023	59.4	19,155,000	17,938,000

[1] Based on average days mines were active in 1955 and 7.0 hours per day.
[2] Included in "Undistributed."
[3] Arkansas included with Colorado.

Mechanical Cleaning

Reports from 18 manufacturers of bituminous-coal-cleaning equipment show that the total capacity of 1956 sales was 11,810 net tons of clean coal per hour compared with 12,610 tons of capacity sold in 1955. However, the annual capacity of 1956 sales, based on average days mines were active in 1955, showed a decrease of six percent from 1955 sales. (See table VII.) Sales in 1956, by type of equipment, in terms of capacity, show that jigs ranked first, followed by dense medium vessels and wet tables. The capacity of all types of equipment sold in 1956 for cleaning bituminous coal by wet methods was equivalent to eight percent of the bituminous coal cleaned by wet methods in 1954, and the capacity of pneumatic equipment sold in 1956 was eight percent of the tonnage pneumatically cleaned in 1954. Approximately 35 percent of the total capacity of cleaning equipment sold in 1956 was for additions to present installations and the remainder, 65 percent, comprised new plants.

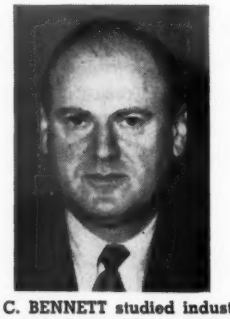
Table VII gives data on bituminous coal cleaned in 1954, by States, and the annual capacity of equipment sold in 1955 and 1956.

Phosphate

Removing overburden with large draglines uncovers Florida's rich, close-to-the surface deposits of land pebble phosphate rock. This state ranks first in production and has 38 percent of the national reserves

1956 saw little expansion in phosphate mining, but the long range trend indicates slow but steady growth

By JOHN C. BENNETT
Manager, Phosphate Rock Department
American Cyanamid Co.



JOHN C. BENNETT studied industrial engineering and industrial management at Purdue University. He came to American Cyanamid Co. in 1946 as assistant to the general manager of production and was soon made assistant to the general manager of the Agricultural Chemicals Division. In 1948 he was promoted to his present position as manager of the division's Phosphate Rock Department. In this capacity, Bennett is responsible for company sales of phosphate rock in domestic and export markets.

PHOSPHATE rock is the basic raw material for practically all phosphorus compounds manufactured in the United States. Its end uses are varied and innumerable. In its many forms phosphorus is required for the manufacture of mixed fertilizers, insecticides, detergents, soft drinks, synthetic fibers, food preservatives, and even the atom bomb.

More important, phosphorus is an essential element in sustaining all forms of life. Without it, plants wither and die. Animals fed on foods deficient in phosphorus weaken and become susceptible to disease.

The process of growing food and fiber for an increasing world population steadily depletes the soil's natural phosphate content. Consequently, the phosphorus content of foods grown from agricultural soils would become insufficient to sustain life if this essential element was not returned to the land in the form of fertilizers.

U. S. Has Large Reserves

Knowing that this practice must continue so long as human beings exist, all nations with an advanced standard of living search continually for additional sources of phosphate rock reserves. The United States fortunately has within its boundaries nearly one-third of the world's known reserves, now totaling nearly 47 billion metric tons.

Our largest reserves of phosphate rock are located in the Midwest in the states of Idaho, Montana, Utah and Wyoming. These deposits constitute about 60 percent of the national reserve. However, at present the Midwest is the nation's smallest producing area for phosphate rock. The deposits are of lower grade than those of Florida, and more difficult to mine.

Florida's phosphate rock deposits are the most extensively mined in the world. The principal product is land pebble phosphate rock, found in matrix ranging from 4 to 25 ft in depth

beneath an overburden of sand and clay from 6 to 40 ft in depth. This state has 38 percent of the reserves.

The nation's remaining phosphate rock deposits of significance are located in central Tennessee, which ranks second in production but has only two percent of the national reserves. The Tennessee deposits are found under a light overburden varying from nothing to 20 ft in depth. The deposits occur in veins varying in width from 1 to 150 ft and in depth from 1 to 25 ft, in contrast to the Florida deposits where the matrix is spread over wide areas in varying depths.

In contrast to the level beds of matrix customarily found in Florida and Tennessee, the midwestern deposits have been subjected to intense folding, faulting and erosion. The matrix is usually found between thick strata of sandstones and shales, and both open pit and underground mining operations are carried on.

In both Florida and Tennessee the overburden is removed and the matrix dug with gigantic draglines. With capacities up to 21 cu yd, the buckets of the draglines can remove as much as 1500 tons of material in an hour.

Trend—Slow, Steady Growth

Regardless of location or method of mining, phosphate rock operations in the United States have two distinct characteristics. In the first place, to remove the rock and prepare it for commercial use requires the investment of millions of dollars in gigantic equipment and plants which produce a basic raw material selling for a comparatively low price per ton.

Secondly, U. S. consumption of phosphate rock is characterized by a slow, steady growth, with frequent declines followed by gradual upswings. This basic industry pattern is in sharp contrast to many other segments of the chemical industry. In 1950, for example, the total U. S. consumption of phosphate rock was 8,580,925 long tons. It reached 10,887,268 long tons in 1954, but has remained fairly close to this figure since.

The following table indicates a comparable current trend in phosphate rock production in the three major producing areas. The figures are in terms of long tons, and all 1956 figures are merely estimates.

It will be noted that in the years cited actual production was greater than total U. S. consumption, requiring carry-over storages and export. Currently, approximately 16 percent of U. S. phosphate rock production is being exported, principally to Canada, western Europe and South American countries.

Agricultural Use

Approximately 60 percent of the total U. S. consumption of phosphate rock is in the form of fertilizers. This market is subject to considerable fluctuation. A number of factors influence the amount of fertilizer used in any given year. The slight downward trend in phosphate rock consumption during 1956 can be attributed to these factors. Dry weather in several western states, an unusually late, cold and damp spring in the East, plus reduced farm income and uncertainties concerning farm legislation had a direct effect in reducing fertilizer sales in the Spring of 1956.

From an industry point of view, the supplying of phosphate rock for fertilizer purposes is further complicated by the fact that fertilizer is a seasonable item. About one-half the total fertilizer tonnage must be moved to the farms within a two-month period. This adds to the expense of manufacture, complicates transportation, delays deliveries and often results in temporary shortages. As a result of this situation, the miners of phosphate rock and the mixers of commercial fertilizers must equip their plants with storage capacity beyond that which is considered necessary by most industries.

Upgrading the Rock

In the supplying of phosphate rock for fertilizer, the industry constantly seeks ways to upgrade the product. Direct application of phosphate rock to the soil now accounts for less than ten percent of the 7½ million long tons of phosphate rock mined annually for agricultural purposes. Since 1900 superphosphate, manufactured by treating ground phosphate rock with sulfuric acid, has been the principal form in which farmers use phosphate rock as a fertilizer. The trend, however, is toward the use of concentrated superphosphate.

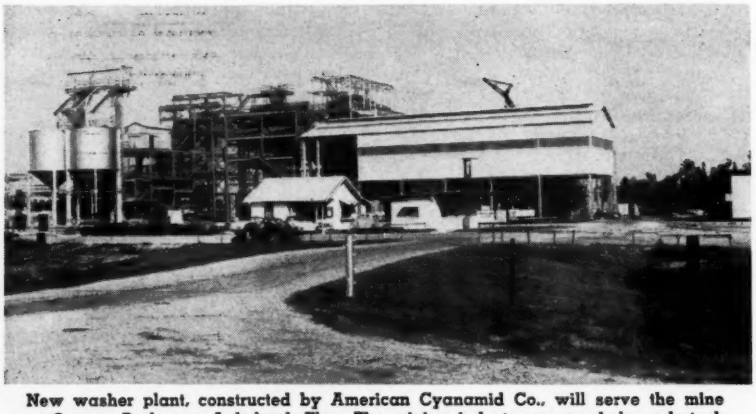
Wet rock storage accumulates in huge piles at a Florida drying plant

It has been estimated that 69 percent of the phosphate rock used for agricultural purposes in 1955-56 was in the form of normal superphosphate. However, farmers used substantially less normal superphosphate in 1956 than they used in 1950. But during the same period, their use of concentrated superphosphate more than doubled. The demand for concentrated superphosphate has required a 120 percent increase in production capacity for phosphoric acid since 1950.

In the "Fertilizer Situation for 1955-56," published by the Commodity Stabilization Service of the U. S. Department of Agriculture, it was noted that between January 1, 1952 and July 1, 1955 the U. S. production capacity for normal superphosphate increased only four percent, compared with an 18 percent increase in production capacity for concentrated superphosphate. Freight increases granted to the railroads by the ICC in

Phosphate Rock Production

Mining Area	*1950*	*1954*	*1956*
Florida	8,085,870	9,730,351	10,400,000
Tennessee	1,384,473	1,700,572	1,700,000
Western	573,044	878,920	900,000
Total	10,043,387	12,309,843	13,000,000



New washer plant, constructed by American Cyanamid Co., will serve the mine at Orange Park near Lakeland, Fla. The mining industry as a whole undertook little expansion during 1956

March 1956 are expected to accelerate this trend toward more concentrated materials.

A relatively small but rapidly growing market for fertilizers is for use on parks, landscaped highways, lawns and home gardens. This market currently accounts for nine percent of the fertilizers sold.

Industry is the second largest user of phosphate rock, taking approximately 24 percent of the total U. S. production. Its principal industrial uses are in the form of elemental phosphorus, ferro phosphorus and phosphoric acid.

Summarizing the importance and broad range aspects of the nation's phosphate mining industry, it can be noted that our phosphate mines and our extensive reserves are one of the nation's most valued assets. The discovery that uranium may be recovered as a by-product of the mining and reclamation processes may make these deposits of even greater value in the years ahead. Also, we can expect a gradual but not startling increase in mining operations and plant expansion to keep pace in the years ahead with the necessity of restoring the depleted phosphorus of our agricultural soils.

Little Expansion During 1956

Commensurate with the slight decline in phosphate rock consumption during 1956, the mining industry as a whole undertook little expansion during 1956. Also, many of the major companies completed construction of new facilities during 1954 and 1955, and comparatively less construction of significance took place during 1956.

American Cyanamid Co. constructed a new washer plant at its Orange Park mine near Lakeland, Fla. This mine will replace operations at Saddle Creek, which was mined out during 1956. To upgrade its basic phosphate rock, the company started construction of a triple superphosphate plant at Brewster, Fla. during 1956. Scheduled to go into operation in mid-1957, the plant will have an annual capacity for 200,000 tons of triple superphosphate.

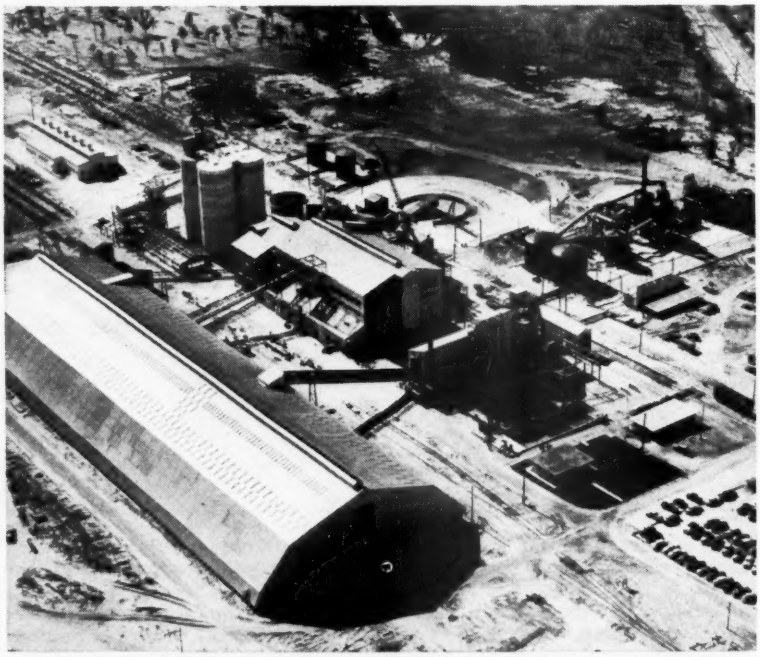
At Ridgewood, Fla. the Davison Chemical Co. is constructing a new office building. The company reports that its production during 1956 ran slightly over anticipated capacity.

Virginia—Carolina Chemical Co. made improvements which are expected to nearly double the phosphate rock production at the Phosmico, Fla. plant. The installation of special conveying, storage and loading equipment at the Nichols, Fla. plant has added to the flexibility of the preparation department operations, while the capacity of the sulfuric acid plant has been increased by approximately 40 percent and the concentrated superphosphate storage facilities have been enlarged by 10,000 tons.

International Minerals and Chemical Corp. introduced minor improvements in technical operations during 1956, and at the Noralyn mine near Bartow, Fla., railroad lines were built by Atlantic Coast Lines with sufficient sidings to double shipping capacity. At the Bonnie chemical plant, production of sulfuric acid will be doubled to increase production of dicalcium phosphate and triple superphosphate. At the Godwin plant in Tennessee the company completed construction of a larger phosphate rock washer as an improvement to facilities purchased in 1955 from TVA.

Armour Fertilizer Works and the American Agricultural Chemical Co. report no significant changes or new construction in their mining operations during 1956. Swift and Company opened a new sodium silica fluoride plant at Apricola, Fla. In the Midwest, the J. R. Simplot Co. opened a new mining site in the Centennial Mountain Range. Called the Centennial Mine, the site is on the Idaho-Montana border about 35 miles east of Monida, Mont. The open pit mine will supply the company with acid grade phosphate rock.

At Anaconda, Mont., The Anaconda Company in 1956 began construction of a 200-ton contact sulfuric acid plant to replace obsolete equipment. The Monsanto Chemical Co., which mines ore north of Soda Springs, Idaho, undertook no major expansion activities in its mining operations during the year.



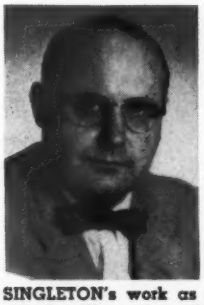
At the Bonnie, Fla. plant of International Minerals and Chemical Corp. the production of dicalcium phosphate and triple superphosphate will be materially increased

Prototype of the earth satellite made of magnesium and plastic replica showing gear it will contain when launched during the current geophysical year

Magnesium

Production capacity is being expanded to meet growing consumer markets. In industrial markets magnesium anticipates certain growth in the alloying and metal reduction fields as a necessary component in the production of aluminum, titanium, uranium and other metals

By JERRY SINGLETON
Executive Secretary
The Magnesium Association



JERRY SINGLETON's work as executive secretary of the Magnesium Association places him in the best possible position to give Journal readers an accurate review of developments in the magnesium business in 1956. His background includes work in journalism as an editor of industrial publications, and previous trade association executive work as assistant to the president of the Pressed Metals Institute.

ANNOUNCEMENT of a second primary producer in 1956, with some indication that this new production may "come in" before the close of 1957, was the high point of 1956. Where 1956 production just touched the 68 thousand ton mark, it is expected that 1957 production by existing facilities will near 80 thousand tons due to improvements known to have added to capacity. This tonnage will be upped by any new capacity brought into operation during the year.

1956 has been a good year for magnesium and all indications point to continued growth during 1957. Accelerated acceptance of magnesium on the one hand and technological development on the other have combined to brighten future prospects. However, it should not be assumed that things are fine for all segments of the industry for the sand casting foundries have been fighting to hold even while die casters suffered from the decline in automotive production. Production and shipment of all classes of product are well up—production by nearly 12 percent; mill products by approximately 14 percent; and castings by 10 percent as anode tonnage grows at a steady pace.

Capacity Expansions

Announcement of plans to build a $7,000,000 plant in Selma, Ala., adding 15 percent to this country's commercial magnesium production total, was made in July by E. Howard Perkins, president and chairman of the board of Brooks and Perkins, Inc., Detroit. He said options have been taken on 480 acres on the Alabama River, 50 mi west of Montgomery, and the plant probably will be in operation in 1957 with a rated annual production capacity for high purity magnesium of 10,000 tons.

Brooks and Perkins and Dominion Magnesium, Ltd., Toronto, will be in joint ownership of the new high purity magnesium corporation—the Alabama Metallurgical Corp. Dominion Magnesium is the only company successfully supplying the world market with high purity metal at competitive prices by the ferrosilicon reduction process. This process is based on the use of silicon as a reducing agent, reacted in the form of ferrosilicon with magnesium oxide obtained from burnt dolomite rock. The raw material is dolomite. Geological surveys throughout the nation began two years ago, with hundreds of tons of dolomite shipped to Canada for full-scale tests by Dominion Magnesium. The Alabama rock, in virtually unlimited supply, was found to be "excellent in all respects."

Other reasons influencing the decision to situate in Alabama were the South's year-round mild climate, which lowers construction costs and gives uniform operating conditions; low-cost fuel in the form of natural gas in nearby fields and a large supply of available labor.

Market Outlook Good

Structurally, magnesium continues to grow in fabricated parts, both as components and complete assemblies. Demands of industry and the military for lower unit weight are turning more engineers to experiments in the lightest structural metal, and excellent "in use" experience is winning more and more new users.

The promotional impetus given magnesium by its selection for the earth satellite has aroused and sparked experimental efforts, some of which hold promise for sound future markets. New markets in electronics, automated work and materials handling are growing steadily while transportation applications are the source of growing demand. Weight saving and ease of machining magnesium have opened markets not even visualized five years ago for one, two and even three-in. plates for tools, jigs and fixtures.

Improved surface finishes of sand castings, additional volume applications which lend themselves to permanent mold casting and the multiple advantages being discovered by potential users of hot chamber die castings are expected to combine to raise structural casting shipments, while the continued growth of the anode market points to a better 1957—probably by 10 to 15 percent.

Finally, magnesium enjoys at least two "must" markets in alloying and metal reduction which are large tonnage users and each of which is growing rapidly. Thus, as production of aluminum, titanium, uranium, beryllium, zirconium and other metals grows, the sales of magnesium must grow too.

The magnesium industry has grown at a steady rate since 1947 and there is no reason to anticipate that such growth will do other than continue. In all probability, a slightly accelerated rate will develop from year to year, a pattern which there is no apparent reason should not be followed in 1957.

Mineral Dressing

(Continued from page 122)

metal technology has improved sufficiently to make ores of progressively lower grade commercial, thus maintaining an ever-increasing production in spite of the exhaustion of the high-grade ore bodies that were responsible for most metals smelted during the 19th century. This progress will continue in the future in spite of the gloomy predictions of those who consider our nation as fast becoming one of the "have nots" in mineral resources. What it takes is men of vision who know what has been accomplished by the pioneers of the past, and is now being done by those of the present; men who can see beyond the obvious and see the possibilities of developing something new and perhaps entirely different. Mineral beneficiation, hydrometallurgy, extractive metallurgy, and even physical metallurgy are all interlocked in the problem. By considering the entire process, from the first crushing to the making of the final product, as a continuous whole, progress will be made much faster than by allowing each part of the process to proceed as if it were a separate entity. Perhaps some of the more recent developments in hydrometallurgy will make some of our low grade oxidized ores commercial. In some cases a hydrometallurgical process is capable of producing refined metals from complex ores without the usual production of a crude impure metal which requires subsequent refining. Some cobalt-nickel-copper concentrates are now processed by hydrometallurgical methods, producing pure metals rather than alloys of the three. It is in this type of hydrometallurgy that solvent extraction, with its highly selective possibilities, could be of great value in the future.

Another interesting field is that of the increasing production of by-product metals occurring in almost trace amounts in some ore, such as molybdenum production from copper ores. The demand and market for some of the rarer or scarcer metals should make every operator investigate his mill products, ores and tailings to see what might be present in sufficient quantity to be studied for possible production. A tailing, already ground, may have something of value in it just waiting to be extracted by some simple means.

With the increasing processing of non-metallics such as cement materials, phosphates, clays, etc., as well as increases in metal production, and the rapid progress in equipment and materials used by the mineral dresser, 1956 has been a year of material progress, and the outlook for even greater advances in 1957 is excellent.

Strategic Metals

(Continued from page 91)

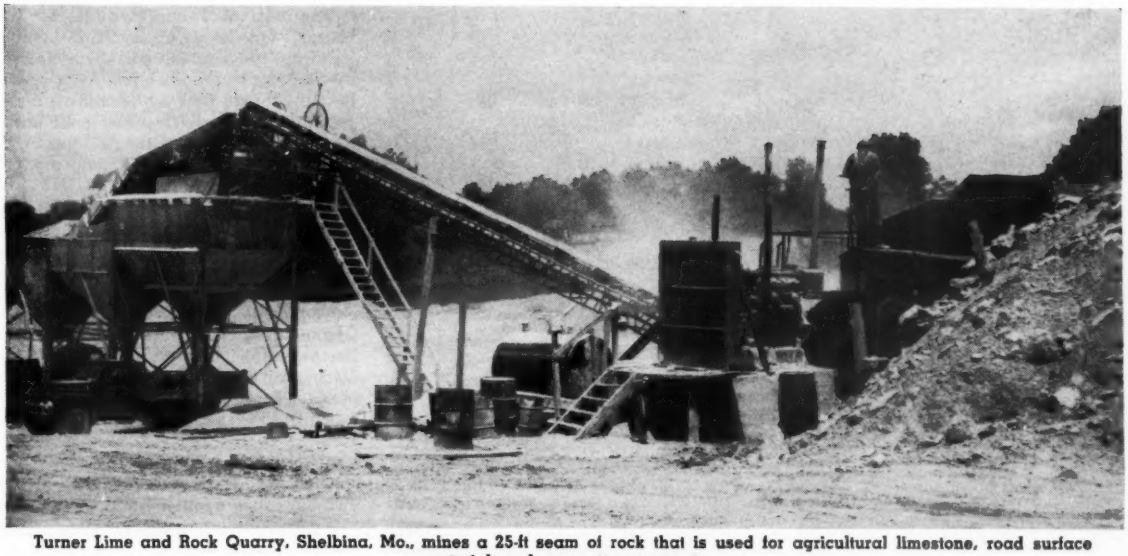
ly, only the ore bodies presently outlined are being mined and exploration work is limited to the zones and areas which are most likely to give quick production. Even so, more metallurgical-grade ore is now known to occur than when the program started in 1951, and the chances are better than they have ever been that the reserves could be increased manyfold if the Government were to take a realistic view of the industry's necessity to National defense.

What effect carload purchases will have on extending and increasing mining and exploration is not presently evident. The success of the modification will undoubtedly depend on the promised long-range program of the Interior Department, as the time before the purchase program ends is too short to encourage widespread prospecting. Success will also depend on the actuating regulations of the modification.

The domestic chrome mining industry, if it is to exist, must be able to explore, develop, and mine. In the United States, where large-scale mining is the only method for competing with cheap labor of foreign countries, the chrome miner, as well as other miners of critical and strategic metals and minerals, must be assured of reasonable returns on the large investments necessary to develop an integrated mechanized operation.

Conclusion

The problems of all domestic producers of so-called strategic metals and minerals are similar. Those which have Government purchase contracts can look to the immediate future with reasonable assurance. Those with only short term price floors, or none at all, face a more uncertain future. Let all of us in the industry hope that the promised mineral policy of the Department of the Interior will be concise and continuing, and consist of something more than the granting of Government loans to explore for metals and minerals which cannot be mined profitably after they have been found.



Turner Lime and Rock Quarry, Shelbina, Mo., mines a 25-ft seam of rock that is used for agricultural limestone, road surface material and concrete aggregate

Industrial Minerals

Following the fortunes of the construction industry to which it is closely tied, industrial minerals experienced an upsurge in activity during 1956

By J. L. GILLSON
Geologist
E. I. du Pont de Nemours & Co., Inc.

Once again we have requested the eminently qualified JOSEPH L. GILLSON to review industrial minerals. As an economic geologist with Du Pont Co., he has a first-hand knowledge of the industry and is able to present a keen analysis of the accomplishments and developments of 1956.

THE production of industrial minerals is tied so directly to the level of industrial activity, and particularly to the construction industry, that statistics of construction are a measure of the production of industrial minerals. According to Engineering News Record, total awards for 1956 were 21.7 billion dollars—16 percent over the previous high set in 1955. Industrial building contracts reached $5.3 billion —81 percent over 1955 and 29 percent over the previous high in 1951.

Producers of industrial minerals provide the sand and gravel and crushed stone, the lime and cement, the clay and gypsum, the asbestos wall board, siding, roofing and pipe, the insulation, the glass and enamel. Every ton of steel required more than a ton of limestone or dolomite as flux; and there was sulphur and fluorspar, mineral pigments, titanium oxide, abrasives and refractories used either in new structures or in the manufacture of the materials for construction.

The St. Lawrence Seaway and the "Dew" Line got rolling in 1956. In August, Congress passed the "Grand Plan" of a National Interstate system of highways to cost eventually some 33 billion dollars in 13 years. The forecast for 1957 is for a total of 5.9 billion dollars to be spent by federal, state and local governments for roads of all types.

In June the new federal stream pollution control law was enacted by Congress with an allowance of a $500,-000,000 fund for building municipal sewage treatment plants in 10 years. Although many sanitation engineers consider the present law too complicated and the annual appropriations inadaquate, a number of major projects are already started. The Department of Commerce estimates that the United States should spend 22.2 billion dollars by 1957 to build an adequate sewage disposal system.

A large number of new water supply and water conservation projects are being planned or are under constuction. Vast efforts and money must be expended during the next decade to supply the needs of a very large part of our population.

Federal aid to schools bogged down in segregation issues, but federal aid or not, tremendous sums are being spent and must be spent to bring the capacity of our schools and colleges up to the growing demand. Another stimuli to future construction which will benefit the industrial mineral producers are the increased activity in the field of state and local public works, and a large number of major dam, lock levee, and other flood control projects.

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AGGREGATES—Estimated production of sand and gravel for the year was 525,000,000 tons. E. C. Knowlton, National Sand and Gravel Association,

Producers of sand and gravel are, in general, moderate-sized companies

estimated that the 1960 demand will be 865,000,000 tons, and the annual demand by 1969, 1.145 billion tons. Prices in 1956 were up in general about 2 percent.

Although sand and gravel deposits are widely distributed, particularly in the northern glaciated states, in the mountains, and along big river valleys, accessible deposits close to large centers are being depleted, and the rapid spreading out of suburbs around the larger cities is covering up future reserves and crowding present operations. The average investment per employe has been about $20,500 but new plants are costing about $27,500 per employe, compared with an average investment per worker in all plants of $12,500. Increased rail freights are stimulating the establishment of small mobile plants and to supply temporary needs.

At least four new plants report using heavy media separation for eliminating poor quality, low density material.

Shipping sand and gravel, as well as cinders and bricks, in heavy duty corrugated containers mounted on pallets is reported from Long Island City according to **Rock Products** for December. The method adapted especially to supplying material for repair jobs in buildings, reduces the inconvenience and messiness of heaps of sand and gravel along roadways and on sidewalks.

The Southern Pacific Railroad is using 75,000 tons of gravel per day in building a 13-mi road bed across the Great Salt Lake. A two mi conveyor system is used.

●

ABRASIVES—The largest deposit of corundum yet discovered in Ontario and the only deposit which has been economically worked, is on the Robillard property in Raglan Township, Renfrew County, according to M. F. Fairlie, in **"Mining and Concentrating Corundum in Ontario."** A discovery of a substantial crystalline corundum deposit is reported in Mozambique from the Revue River area, 45 miles from Vila Pery. The new find is in the government Inchope tin reserve.

A study of the hardness of various abrasive products is reported by E. T. Tangerman, writing in the **American Machinist**, vol 100, pp. 153-74, June 1956. His unit is the "Knoop" hardness K 100.

Hardened tool steel, Rc 60.5	740
Quartz	820
Garnet	1360
Tungsten Carbide	1400-1800
Alumina	2000
Titanium Carbide	2470
Silicon Carbide	2500
Titanium Boride	2700
Boron Carbide	2800
Diamond	6500

Edwin C. Lowe of the Norton Co. was issued a U. S. patent on May 22, 1956, for a new process to make boron carbide, using 2 to 5 percent alumina. A patent was issued to Edward van der Pyl of the Norton Co. on a method of synthesis of silicon carbide. A number of patents were issued during the year on new methods of making abrasive wheels.

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ASBESTOS—Just before the first of the year, Johns-Manville Corp., Ltd., announced a price increase on all grades. Carload price for No. 1 crude was increased from $1300 to $1400 per ton, No. 2 from $675 to $750, No. 3R from $371 to $408. Increases on short fibers were 4 to 5 percent.

The mill of Johns-Manville at Asbestos, Quebec, already the largest building in Canada, will be enlarged by 75,000 ft of additional floor space. It will provide four additional primary milling lines, bringing the new mill's production facilities to 16 lines with an annual capacity of 625,000 tons of fiber.

The New Lafayette Asbestos Co. is continuing work at its property in Richmond County, Ontario. The other operator in Richmond County besides Johns-Manville, is Nicolet Asbestos. National Gypsum Co. has announced that a new multi-million dollar asbestos mine and plant at Thetford Mines, 40 miles to the northeast, will be put into operation to supply asbestos fiber to National Gypsum's three asbestos cement plants in the United States. The firm purchased a tract of land from Bell Asbestos Mines and has since acquired additional land to make a 500-acre tract. Production is expected in 1958.

The most interesting development in the eastern townships, however, is the preparation for a large scale mining and milling operation by Lake Asbestos, of Quebec, Ltd., a subsidiary of the American Smelting and Refining Co. Here $32,000,000 is being spent to remove 35 to 40,000,000 cu yd of silt, clay and sand from the bottom of a lake, which will then be drained, and for the building of a mill of 4000 to 5000-tpd capacity. Diamond drilling and underground exploration has indicated that sufficient ore occurs in two main zones to support a mining and milling operation for at least 25 years. In order to prepare for the dredging and draining, it has been necessary to divert a river which involved construction of dams and a diversion canal. One dam is 2900 ft long and required 10,000 cu yd of earth fill and has a rock fill spillway 350 ft wide. The South Neck Dam across Black Lake required some 170,000 yd of earth fill. The main disposal area was created by damming a valley. This dam is 4700 ft long. The huge dredge removing the silt in the bottom of the lake has a suction pump with a 34-in. suction line powered by a 6000-hp motor. The cutter head requires an 800-hp motor and two booster pumps with 6000-hp and 2500-hp motors to force the slurry 18,000 to 21,000 ft to the storage areas.

About 1,000,000 tons of solids are handled monthly.

Construction of the mill is already under way, and is expected to be completed in 1958.

Other companies active in the Black Lake-Thetford district in addition to Bell (now sold to National Gypsum) are the Asbestos Corp. which operates four mines, Johnson Asbestos Co. operating two mines and Flintkote Mines. Twenty mi east at East Broughton, Quebec, Asbestos treats 1900 tons per day and on the ad-

joining property Carey-Canadian Mines Co. is developing a new ore body and erecting a 2000-ton mill.

Eastern Asbestos Co. is also prospecting in Megantic County near Thetford Mines, and is conducting underground exploration in the Ottawa Valley, 24 mi from Buckingham where a 200-tpd mill is being built.

In northern Ontario, Johns-Manville is continuing its underground development at its Munro mine in the Matheson area between Kirkland Lake and Cochrane.

In British Columbia, Cassiar Asbestos Corp., Ltd, claimed a net profit for 1955 of $686,092 on the sale of asbestos valued at $4,749,541. Ore reserves are estimated at 6,766,987 tons. A ropeway has been constructed to bring the ore down the mountain.

The asbestos deposits of Arizona were described in May 1956 by L. A. Stewart in U. S. Bureau of Mines, Information Circular 7745. Most of the deposits are in the vicinity of Globe; others are in the Grand Canyon and still others in the southeast, not far from Tombstone. In the Globe area, Stewart recognizes 57 mines. The asbestos bearing strata are in the Mescal limestone of the Apache group, of pre-Cambrian age. The Apache group has been intruded by diabase sills from a few in. to several hundred ft thick. Most of the mines lie within an area 6 by 12 mi in the Crook National Forest, the Fort Apache and the San Carlos Indian Reservations.

In Australia, the Commonwealth and Western Australia Governments are subsidizing the asbestos industry in the Wittenoom Gorge project, where mines are owned by the Colonial Sugar Refining Co. The subsidies will amount to $12.50 per ton, with a limit set at 6000 tons. The mines produce a long-fibered blue asbestos. Johns-Manville has signed a contract with the producer for 7000 tons per year for the next five years. It is understood that the price is $225 per ton.

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NATURAL ASPHALTS—Materials have been considered generally to be an industrial mineral since they went into paints and varnishes and onto roads. However, now the most famous one, gilsonite, has become essentially a crude petroleum source. The new hydraulic jet mining development in Utah has been much in the news having been described in MINING CONGRESS JOURNAL for August.

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BARITES—American Colloid Co. of Chicago is constructing a dam and plant for mining barite in the Muddy Fork area of Nashville, Ark. In the Battle Mountain area, in the northern part of Lander County, Nevada, two companies are operating, Magnet Cover Barium Corp, and Barium Products, Ltd. The former put its new 175-ton mill into full operation early in the year. The mill draws ore from the Greystone mine which operates only nine months of the year, but ore is stockpiled at the mill to carry the mill through the winter. Barium Products operates the Mountain Spring mine, 26 mi from Battle Mountain, but is developing another mine called the Argenta only 12 mi from Battle Mountain.

Magnet Cover Barium Corp of Houston, Tex., has purchased Canadian Industrial Mineral which operates the large barite mine at Pembroke, Nova Scotia, and a 400-ton mill at Walton. This is one of the largest deposits in the world. Most of the production has gone to the Caribbean area for use in oil well drilling mud. In Alaska, the Territorial Department of Mines reports that small deposits of barite are widespread, but the only one of commercial possibilities is on one of the Castle Islands in Duncan Canal on patented ground held by the Alaska Juneau Gold Mining Co.

Barytes ore was used for concrete aggregate in the construction of a reactor pool in the nuclear research center of Battelle Memorial Institute in Columbus, Ohio, in order to provide a high density concrete.

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BORAX—For nearly a century borax produced in California has been a familiar product, but only in our kitchens and laundries. Now boron compounds are poised for a burst of exciting new uses, into glass, glazes, flameproofing agents, enamels, adhesives, resins and to a whole new field of chemistry. With the prospect of common usage of an organic boron compound as a jet fuel, there is no telling how far this new path will lead. Meanwhile the metal as a carbide is forming one of the hardest known synthetic abrasives.

Olin Mathieson Chemical Corp. and Callery Chemical Corp., Inc., the latter being a wholly owned subsidiary of Mine Safety Appliances Co., are prime contractors for a $71,000,000 program to develop high energy fuels. The boranes are a series of compounds of boron and hydrogen formed during the fractional distillation of the stable hydrides B_2H_6 and B_4H_{10}. Whereas one gram of coal releases 8000 calories when burned, diborane B_2H_6 releases 16,000 calories per gram when burned. Decaborane is said to be the most interesting of the borane compounds.

The borax sold in 1953 amounted to 715,000 tons, but these organo-boron compounds are expected to lift the demand past 1,200,000 tons in 1960 and perhaps to 2,500,000 in 1965. The extended research programs of the three major producers bespeak their interest. U. S. Borax and Chemical Co., which had a research budget of $300,000 in 1955 is scheduled to spend $750,000 in 1958. It has built a new $1,000,000 research center at Anaheim, Calif. American Potash and Chemical Corp., second largest borax producer, doubled the space of its laboratory at Whittier and half of its research staff has been on boron since 1953. Stauffer Chemical Co. has perhaps the greatest research budget on boron, conducting work at Chauncy, N. Y., and Richmond, Calif.

Pacific Coast Borax Co., a British owned company, merged with U. S. Potash Co. in 1956. This company has budgeted some $18,000,000 for expansion and modernization of its plant at Boron, Calif. The underground mine is to be converted to an open pit, requiring the removal of 9,000,000 tons of overburden.

The old Western Borax mine, also at Boron, Calif., was acquired by the Seeley W. Mudd family and is being reconditioned and deepened. A production of 300 tpd is planned.

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BORON carbide as an effective nuclear shield. Boron Nitride as made by the Carborundum Co. is used in rocket nozzles. Johns-Manville Co. is building a plant for the manufacture of synthetic silicates at Lompoc, Calif.

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CERAMICS — Ceramics may be described as the erudite section of the industrial mineral field. Much has been written in the past year on the subject but it is so diverse and highly technical that it is impossible to digest and summarize the developments of

Salt operation in Texas

the year in any permissible space:

Constitution of bone china, high temperature phase — equilibrium studies in the system tri-calcium phosphate-anorthite-silica, P.D.S. St. Pierre. *Jour. Amer. Ceramic Soc.* April 1956, pp 147-150.

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CLAYS—The structural clay products industry which showed a steady decline throughout the depression and World War II is coming back at a fast pace. In the last two years the clay products industry has expanded rapidly. Brick and tile producers hiked their capacity 4.2 percent in 1956 to 12.547 billion brick equivalents. The peak production in 1925 was 13.900 billion brick equivalents, while in 1953 only 7.6 billion units were produced. Brick accounts for the great bulk of structural clay products.

Near a deposit in Bedford Canyon, five miles south of Corona, Calif., a plant to cost $3,000,000 is under construction to produce various types of clay products.

Plans by The Anaconda Co. to build a pilot plant to extract alumina from a large clay deposit near Moscow, Idaho, were announced late in the year. In spite of the fact that research on extraction of alumina from clay by government plants at Salt Lake City, Salem, Ore., Laramie, Wyo., and Larleyville, S. C., were discouraging, Anaconda has a strong incentive for achieving its goal since it now must depend on Reynolds Metals Co. for bauxite and it has only a five year contract with Reynolds. In addition bauxite deposits are remote from Anaconda's aluminum plant. Harvey Aluminum Co. is also interested since it has large reserves of clay near its Washington plant but is momentarily dependent on the Japanese for its alumina.

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DIAMONDS—Output of diamonds hit a new high in 1956 with an unsurpassed demand in the United States for both gem stones and industrial diamonds. Production of both types of stones has been pushed to the highest level ever reported by the De Beers Consolidated Mines, Synd. Diamond merchants in Johannesburg estimate that the prices being paid by U. S. importers for high quality stones have risen 2 to 5 percent in the past year, while prices of lower quality stones are up a third. Industrial diamonds are up about 20 percent in price over last year's average.

However, diamond sales by the De Beers Central Selling Organization, which controls over 90 percent of the world's diamond sales, totaled $153,608,000 in the first nine months of 1956 compared with $157,080,000 in the comparable period of 1955. Sir Ernest Oppenheimer declares that the reason for the reduction in sales was a smaller supply of diamonds. The sales in the first nine months included $103,000,000 for gems and $50,-600,000 for industrial stones. Industrial diamond consumption currently is bolstered by U. S. Government purchases for the stock pile. The Belgian Congo is the world's largest producer of diamonds by weight, but 94 percent of these are of industrial quality. South Africa, southwest Africa and the Gold Coast (now named Ghana) are the leading gem producers in that order. Consolidated Diamond Mines of southwest Africa and Williamson Diamonds, Ltd., of Tanganyika are the only producers with an easy supply situation. A heavy media separation plant was installed by Williamson Diamonds in 1956.

Consolidated Diamond Mines of Southwest Africa had raised its monthly output to 70,000 carats at the beginning of the year. Steadily increased production came from the terraces at Saddle Hill North, Luderitz district by Industrial Diamonds of S. A., Ltd., and Kimberley West Diamond Corp, Ltd., reported that a new field had been discovered south of the border of Angola.

In Angola itself the diamond industry is one of the most important single economic activities. Companhia de Diamantes de Angola installed heavy media separation and is constructing its own hydroelectric plant near its mining activities in northeastern Angola. The company treated 1,480,442 cubic meters in 1955 and recovered 743,378 carats.

Production of diamonds in British Guiana in 1955 was 35,000 carats.

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DIATOMACEOUS EARTH — Reports on deposits of diatomite in Alaska, Nigeria and Arizona appeared during the year. A U. S. Patent, No. 2,764,516, was issued to H. A. Pace of the Goodyear Tire and Rubber Co. covering the use of diatomite with an alkyd resin and an organic polyisocyanate in the manufacture of foamed, cellular sandwich panels for sound and heat insulation. Salt shakers with filters made of diatomite are being manufactured at the rate of several thousand daily by the Airko Co. at Clermont, Fla.

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DOLOMITE—A 10,000 annual ton "high purity" magnesium plant, using dolomite as the mineral raw material, is under construction at Selma, Ala., by the Alabama Metallurgical Corp. The United States Lime Products Corp. is modernizing its plant at Henderson, Nev. It calcines the quarried dolomite.

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FELDSPAR AND NEPHELINE—At Spruce Pine, N. C., the Lawson Feldspar and Minerals Co. purchased the plant site and all the mines of the old United Feldspar and Mineral Corp. The plant burned down several years ago and a modern flotation plant is being built to produce 10,000 tons of feldspar concentrate per month from large alaskite deposits. Also at Spruce Pine, the Chesapeake and Colorado Corp. is building a plant to treat ore from Mt. Celo and other mines.

In Tennessee, International Minerals & Chemical Corp. completed a feldspar beneficiation plant using electrostatic separation. In Blue Mountain, north of Peterboro, Ont., the corporation has completed its plant for producing 100,000 tons per year of nepheline. Also at Blue Mountain, American Nepheline, Ltd., a subsidiary of Ventures, Ltd., expanded its plant at a cost of $2,500,000, with an initial capacity of 600 tpd. A 17½-mi spur line has been constructed by the Canadian Pacific Railway from Havelock to the plant site at Nephton.

FLUORSPAR—World production of fluorspar for the years 1946 to 1955 was reported by Helen L. Hunt in *Mineral Trade Notes* of May 1956. These figures show that out of a total world production, including Russia, of 1,400,000 short tons in 1955, Europe produced 620,000 tons or 44.3 percent while North America produced only 39.7 per cent, 556,373 tons. All of the Russion production is credited to Asia. The United States was the largest individual producer with 279,540* tons followed by West Germany with 176,370. Mexico was third with 145,105 tons followed by Canada (mainly Newfoundland) with 131,728. Italy and the United Kingdom were the only other countries with production of over 100,000 tons.

With figures for only the first three quarters of 1956 available, the statistics show that the United States produced 232,883 tons of all grades in nine months (for an annual rate of 300,000 tons.) Consumption of all grades was 458,512 tons for nine months (for an annual rate of 610,000). Consumption in 1955 was 566,636 tons. For the nine months in 1956 Mexico supplied 101,688 tons of acid grade, 47 per cent of the total 216,941 tons imported. Italy was second with 61,527 tons. Mexico also supplied 157,409 tons of metallurgical grade out of total imports of 242,124 tons, both for consumption and storage. Canada was second with 66,256 tons. These figures are confusing because most of what is imported from Canada is used as feed for the flotation plant at Wilmington, Del., and is converted to acid grade. The figures show that whereas only 17 tons of acid grade fluorspar were imported as such, from Canada, 30,184 tons of acid grade were sold for consumption. During the nine-month period 24,224 tons of the acid grade imports from Mexico went into bonded warehouses, presumably all for the Government stockpile.

Since the average U. S. production for 1944 to 1948 was 335,380 tons and the maximum production in 1951 was 347,024 tons, the 1956 production of 300,000 tons was not a serious reduction.

The United States Geological Survey completed a restudy of domestic fluorspar reserve and came up with a figure of 22,500,000 short tons of ore containing 35 percent or more of CaF_2. No estimate was given as to the price level at which these various reserves could be mined pofitably.

Prices of all grades of fluorspar advanced during the summer as follows: metallurgical, 72½ percent effective, from $35 to $37; 60 per cent effective from $30 to $33 and acid grade from $47.50 to $52.50 f.o.b Rosiclare, Ill.

* The figure given in Fluorspar Report No. 88, December 20, 1956, by the U. S. Bureau of Mines, was 291,275 tons for 1953.

The appeal that had been made in August 1955 to the Tariff Commission for relief under the "Escape Clause" by several domestic producers (and some that were not producers) was acted on on January 18, 1956, resulting in a split decision, three commissioners voting to withdraw the GATT concession on acid grade fluorspar and three commissioners voting against the withdrawal. Hearings were set later by the Office of Defense Mobilization to restrict imports, but these were delayed because of legislation pending in Congress calling for further purchases of fluorspar for stockpiling. The hearing was held finally on November 12. Congress voted authorization for the purchase of 250,000 short tons of newly mined acid grade spar by December 31, 1958, at $53 per short ton with lower prices for material of lower grades.

Up until the end of the year, purchases had been negligible. However, the domestic industry was benefited by a steadily increasing demand from a booming steel industry, a rapidly expanding aluminum industry, and by the ingenuity of research chemists who keep finding new fluorine bearing compounds and applications for them. The uranium industry, now taking 60,000 tons of acid grade, is expected to need 200,000 tons a year by 1960. Also, Mexican producers which had been giving the domestic producers such stiff competition were having some troubles of their own, due to shortsightedness in keeping up development work. As the easily mined spar becomes scarcer, the cost of production is rising and more mechanical equipment is being utilized. Almost an identical story could be given for the Spanish producers.

The St. Lawrence Seaway presents a growing threat to domestic producers, and at least one, and probably two, drying plants are planned for Cleveland to handle imported filter cake.

All is not gloom, however. In the Rosiclare district Minerva installed lead and zinc circuits in its Crystal Mill to handle reserves of sulphide bearing ores. The old Victory mine workings have been completely redeveloped for underground diesel truck haulage. Minerva also has redeveloped the old Defender workings on the Austin property. Gil Montgomery of Minerva described their program of diesel haulage in *Mining Congress Journal* for November 1956. Alcoa was busy on its properties. Two new orebodies were discovered on the Extension works; sinking of a 225-ft shaft was started in July into a bedded deposit five miles from Joy, Ky.

This modern truck haulage system is typical of those to be found in cement plant quarries today

A discovery of importance was announced in Mineral County, Montana, on the headwaters of Fish Creek by Mort Bacon, a rancher and guide.

In Newfoundland, both companies operating here have been busy. Newfoundland Fluorspar, Ltd. (subsidiary of Aluminum of Canada) expected to mill 125,000 tons of crude ore through its heavy media plant. The concentrates and fines are all shipped to the company's flotation plant at Arvida, Que. The other company, St. Lawrence, also puts its production, which comes from four mines, through heavy media plants, and ships the concentrates and fines, estimated at 75,000

tons to its U. S. associate which operates a flotation plant at the Marine Terminal in Wilmington, Del. Most of the flotation concentrates is held for the stock pile.

In Mexico, La Fluorita de Mexico, completed the expansion of its mill at Muzquiz and expanded its mining operations at the La Encantada and Buena Vista mesas in northwestern Coahuila. Reynolds began to get its properties in the Paila district ready for mining and was building a flotation plant at Eagle Pass, Tex. Asarco kept its mines going at Paila to feed its plant at Agujita. It also operated the Milagro claim at Buena Vista.

In the Rio Verde district in the state of San Luis Potosi, there are two adjacent operations producing metallurgical grade. One of these, La Consentida, operated by Minerales de Metales Industriales, a wholly-owned subsidiary of Pennsalt International Corp. of Philadelphia, claims to have reserves of 200,000 tons of ore. The ore body is mined by bench mining. The other mine is called Las Cuevas and has shifted its operations underground, working at levels of 90 and 150 ft, and developing at 210 ft. Output is at the rate of 60,000 tons per year.

The Azul mine, near Taxco, which was such a large producer during World War II has been sold to Spanish interests.

La Fluorita de Mexico brought its mine in the state of Guanajuato into production during the year, shipping from Tampico.

There was a sharp rise in the number of communities using water fluoridation to combat tooth decay with over 30,000,000 people now using Fluorated water.

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GEMS—The world's largest emerald mine at Muzo, about 100 mi north of Bogota in Columbia was reopened. The rich Yogo sapphire deposit in Judith Basin County, 60 mi northwest of Billings, Mont., has been acquired from its British owners and will go back into production. The new owners are the Commercial Uranium Mines of Denver and Thomas P. Sidwell of Billings. Cut stones worth $30,000,000 were taken from the deposit between 1900 and 1927. A single piece of jade, weighing at least 2000 lb has been hauled out of the Jade Mountain area to Kotzebue in northwestern Alaska and is waiting shipment to the Orient where the owners expect to find a better market.

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GLASS—The glass industry is undergoing a tremendous upsurge and some 1.7 billion dollars worth of products were sold in 1956. Corning Glass states that 75 percent of its revenue in 1955 was from products not in existence in 1940.

Libby-Owens Glass Co. has spent $54,000,000 increasing its plate glass production facilities 50 per cent in the last 16 months. Pittsburgh Plate Glass Co. has been concentrating on a building material called Sandrelite for exteriors for small store fronts to skyscrapers. It is a heat-strengthened glass with ceramic color fused into it and is available in panels up to 48 by 84 in. The same company is making windows up to 84 in. thick to serve as radiation shields in nuclear research, and it recently installed a heat absorbing glass on the bridge of the new air-craft carrier Forrestal to reduce the noise of jets. Another interesting glass is "dusk light" which admits only 25 to 30 per cent of outside glare so that whole walls can be made of glass. In 1955 the automobile industry used 5000 acres of flat glass.

Libby-Owens-Ford has perfected its Thermopane with a new method of fusing the glass edges without metal, thus decreasing the cost which has been high. The material is being aggressively pushed for chicken and pig houses to control animal growth. Architects are adopting the idea of sliding walls composed of glass in contemporary houses. Fiberglass fly screens that will withstand a flying baseball were introduced last year.

L. O. F. Glass Fibers Co. has a micro-quartz insulation that will withstand 2500 degrees F. The C.A.A. announced that this is the first fireproof insulation ever tested by that agency for airplanes.

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GRAPHITE—The world production of graphite from 1946 to 1955 was given in *Mineral Trade Notes* for April. Surprising as it may seem, the Republic of Korea jumped into first place in 1955, with a production of 99,228 tons. Mexico was second with 32,342, followed by Austria with 19,637 and Madagascar with 16,194 tons. The only other countries producing over 10,000 tons were West Germany and Ceylon.

A method for melting and welding graphite was announced at National Carbon Company's research laboratory at Parma, Ohio. The technique suggests the possibility of prefabricating sheets and panels for the assembly of nuclear reactor moderators.

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GYPSUM—Although the mining of gypsum in the United States is not an important industry as such, the manufacture of gypsum products reaches a value of $250,000,000 per year. It is thus one of the very important industrial mineral products.

The largest company in the industry is U. S. Gypsum, accounting for close to half of the volume. It operates 27 gypsum properties and plants of which five are located in eastern Canada and one in Jamaica.

National Gypsum Co., which accounts for about 25 per cent of the business, announced a $19,000,000 expansion involving two gypsum products plants at Lorain, Ohio, and Waukegan, Ill., and the development of a 75,000,000 ton deposit at Tawas City, Mich. Construction of the plants along with docks and harbors will begin in 1957. Lake ore ships will transport the gypsum from the mine to the plants. A plant at Burlington, N. J. was completed with docks at which boats bringing cargoes from the company mine in Nova Scotia can unload.

Kaiser Gypsum Co. completed the exponsion of its plant at Long Beach, Calif. Kaiser draws its gypsum from a quarry at San Marcos Island in the Gulf of Lower California. This deposit is operated by a wholly owned subsidiary, Compania Mexicana Occidental. Kaiser also owns extensive gypsum reserves near Gerlach, Yeringon and Las Vegas, Nev.

The Celotex Corporation completed in 1955 a $3,500,000 expansion of its gypsum plant at Port Clinton, Ohio, which doubled capacity. Since there are four gypsum seams in the quarry face, 37 ft high, and dolomite tends to contaminate the product, a heavy media separation plant was installed.

Flintkote, another large gypsum producer, acquired three companies: Insulrock Co., VanPaker Corp., and U. S. Lime Products Co. It is building a gypsum plant in Texas and an Insulrock plant in Indiana.

Johns-Manville Corp. optioned the Lucky Gypsum property in southern Nevada located between Henderson and Las Vegas. Pabco Products has completed a gypsum plant at Newark, Calif., a roofing plant at Wilmington, Calif., and is currently building a gypsum plant at Florence, Colo. Its deposits are at Lovelock, Nev. Bestwall Gypsum Co. has been organized at Ardmore, Pa., to acquire and operate eight gypsum and paper products plants, formerly owned and operated by Certain-teed Products Co. at Fort Dodge, Ia., Grand Rapids, Mich., Blue Rapids, Kans., Acme, Tex., Akron, N. Y. Sigurd, Utah and the paper mill at Pryor, Okla. It also will have a fibreboard and newsprint plant at Thorold, Ont. and will develop gypsum deposits in Nova Scotia.

Western Gypsum Products, Ltd, of Winnipeg, a wholly owned subsidiary of British Plaster Board Ltd. of London is building a gypsum products plant at Vancouver Harbor, B. C., and will bring gypsum from San Marcus Island. The company also has a gypsum mine in Manitoba and product plants at Winnipeg and Calgary.

In Newfoundland, gypsum is quarried at Flat Bay on the west coast and used in the manufacture of wall board at Corner Brook.

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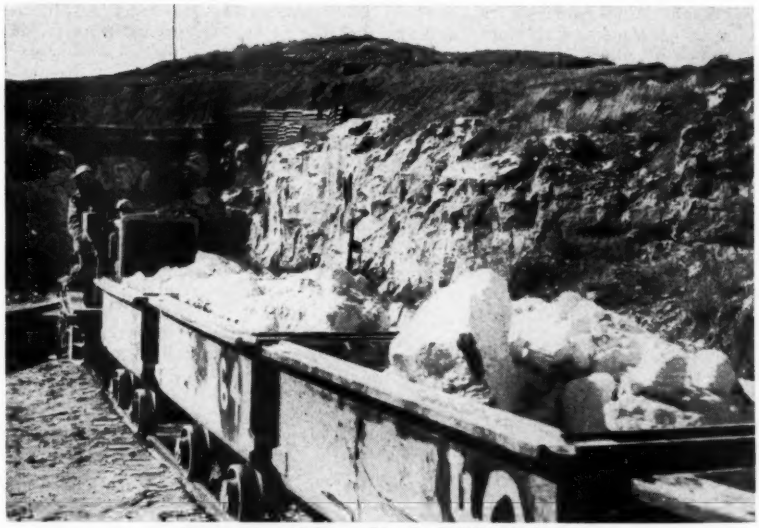
KYANITE — Carolina Mines, Inc., began operations at a deposit between Kings Mountain and Croder's Mountain, N. C.

The rich kyanite deposits at Murka



Gypsum is widely used in the building industry

Hill in the Tsavo Game Park in Kenya has been taken over by the New Consolidated Gold Fields, Ltd. Gold Fields Kyanite Refractories, Ltd., has been formed to develop the property and market the output.

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LIGHT WEIGHT AGGREGATES—Large scale consumption of light weight aggregate has developed only in the last five years. Two processes for manufacture account for 95 percent of that produced, the rotary kiln and the Dwight-Lloyd continuous grate sintering process. The geographical distribution of plants is widespread with virtually no area in the country unrepresented. The largest plant is in North Carolina, but the largest producer operates plants in Texas, Louisiana and Oklahoma. The major consumer is the manufacturer of building blocks. Whereas in 1947 the total number of light weight blocks was 460,000 units, it increased to 950,000,000 by 1954 and should double again by 1975.

The other large volume use for manufactured lightweight aggregate is in structural concrete. High strength designs, above 9000 psi are possible, as well as low density mixes, with concrete weighing less than 50 lb per cu ft. The concrete is tough, has good insulating value, and has an inherent fire resistance above that of sand and gravel concrete.

Although slag and cinders still account for about 60 percent of the light weight aggregate used, the proportion of manufactured product is expected to rise rapidly as the industry grows.

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LIME AND LIMESTONE — The United States Lime Products Co. of California, with three plants in the Las Vegas, Nev., area, has been bought by Flintkote Co. of Rutherford, N. J. The Chemical Lime Co., Portland, Ore., is completing its large chemical lime plant near Baker, Ore. Wyandotte Chemicals Corp. announced a multimillion dollar modernization of its quarry at Alpena, Mich. The Bethlehem Steel Co. has started a program to increase its limestone facilities. A thousand acres of land has been purchased at Hanover, Pa., to supply additional limestone reserves and several million dollars is being spent to modernize existing plant and quarries. U. S. Steel has acquired large limestone resources on Wasleigh Island in the Ketchikan area of southeastern Alaska to supply Columbia Steel of Utah. In the same general area the Edna Bay Pure Stone Co. has leased properties owned by the Aluminum Co. of America to supply its lime plant at Vancouver, Wash.

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LITHIUM—The subject of lithium has made much more publicity, and mining development in lithium ores has consumed much more money than any reasonable expectation of near future market seems to justify. The 1956 capacity of six plants to produce lithium chemicals, expressed as lithium carbonate equivalent, is 2.2 times the 1956 demand, and 1.5 times the estimated 1960 demand, as shown in the following table quoted from an article by R. W. Hyde in the *Canadian Mining Journal* for May:

Producer and Location	Lithium Supply in equiv. lbs.	Use	Lithium Demand in equiv. lbs. 1956	1960
American Potash & Chemical, Searles Lake	2,000,000	Greases	3,000,000	4,500,000
American Lithium Chemicals, San Antonio, Tex., American Potash 50.1 percent and Bikita Minerals, Ltd.	6,000,000	Ceramics and glass	2,300,000	4,500,000
Foote Mineral Co., Sunbright, Va.	5,300,000	Aluminum welding	1,200,000	1,600,000
Lithium Corp. of America, Minneapolis, Minn.	1,400,000	Air conditioning	1,500,000	2,000,000
Lithium Corp. of America, Bessemer City, N. C.	8,400,000	Alkaline storage batteries	650,000	700,000
Maywood Chemical Works, Maywood, N. J.	700,000	Military and A.E.C.	1,730,000	2,660,000
		Miscellaneous	300,000	400,000
Total	23,750,000		10,680,000	15,360,000

Since 15,360,000 lb is only 7600 tons, there does not seem to be justification for a dozen mines to be rushing into production. The dream that keeps people active in lithium is presumably the fusion reactor, but there is a "gimmick" in this possibility. As described by Hans Thirring in *C. & E. News* for Nov. 21, 1955, the fusion reaction can be maintained only with the light isotope Li^6 which constitutes 1/13 of the lithium found in nature. Hence the A.E.C. would use only 1/13 of the lithium that they might buy, and return the rest to industry. The larger the A.E.C. use, the bigger the over supply of lithium for commercial uses.

The only new use that has been proposed for lithium and which might conceivably be large is that, because of its low melting point (186° C.) and a very high boiling point (1336° C.) it may be a coolant in nuclear reactors, or as the heat carrier from sources of intense heat, such as solar "furnaces" to boilers for production of steam by conventional methods. Dominion Magnesium, Ltd., has stated that magnesium alloys with 12 percent lithium, under development by the U. S. Navy, have shown the highest strength-weight ratio of any structural material and an extraordinary capacity for deformation in shaping.

In Manitoba, 12,000,000 tons of lithium ore are blocked out and $5,000,000 will be spent when the mine goes into production in 1957. The Manitoba Government has spent $250,000 for a road near the Cat Lake-Bernic Lake area and has built a

$100,000 hydro line. The Lithium Corp. of Canada will start production from its Cat Lake mine by shipping ore to Britain for processing tests. Development work was under way by Dunvegan Mines, Nama Creek Mines and Jean Lake Lithium Mines, all in the Beardmore area. In northwestern Quebec, Quebec Lithium started its 1000-tpd mill, costing about $2,500,000 near Val d'Or. The company has a contract with the Lithium Corp. of America for 165 tpd of spodumene with a price of $11 per unit of contained oxide.

In the United States, Foote Mineral Co. has appropriated $500,000 to improve facilities at Kings Mountain, N. C. Lithium Corp. of America announced completion of the first phase of its expansion program to produce lithium metal for use in the field of "high energy fuels." Basic Atomics, Inc., is drilling at Kings Mountain. The Assistant State Geologist of N. C. states that North Carolina contains enough reserves to last the current rate of production for 75 years. In San Antonio, American Lithium Corp. and Bikita Minerals of South Africa started their lithium chemical plant in December. The ore used is lepidolite, from Southern Rhodesia.

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MAGNESITE—World production of magnesite for the period of 1946 to 1955 was given in *Mineral Trade Notes* for April. As usual, Austria was the largest producer with a production of over 1,000,000 short tons in 1955; the United States was next with 656,784 tons; Yugoslavia was a poor third with 129,114 tons, followed by India, Greece and Australia.

The only news from Austria was that Radenthein Magnesite A.G. plans to start mining the long known Hochfilzen-Leogang deposit and erect an ultra modern furnace.

In the United States, the Northwest Magnesite Co. has increased production at Chewelah, Wash., now that the steel industry is running near capacity.

Standard Lime and Cement Co. is doubling its magnesite plant at Manistee, Mich., to be completed by June 1957. An additional rotary kiln, additional thickeners and settling basins, with companion equipment will be installed.

Kaiser Aluminum and Chemical Co. has announced an expansion program to increase production of refractory and magnesia products to cost $3,000,000. New facilities are to be added to the seawater magnesia plant at Moss Landing, Calif., and the basic refractories plant at Columbiana, Ohio. The capacity at Moss Landing will be doubled, with a new kiln to bring daily kiln capacity to 375 tons. This is the second major expansion in two years.

Potash Co. of America has entered into an agreement with the Canadian province of Saskatchewan to explore 100,000 acres in the Quill Lake area. The mineral carnallite KCl • $McCl^2$ • H_2O was discovered during the course of drilling in the area for potash. Interestingly enough, the bed, which is a mixture of carnallite and common salt, carries two lb of bromine per ton of ore.

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MICA—The domestic mica mining industry was bolstered by an announcement of two new policies by the government. The purchasing program was extended another five years until June 30, 1962, and the price paid to miners for mica bought at any of the three government purchase depots has been increased. The effect of these policies in the Spruce Pine, N. C., area was almost instantaneous. A number of inactive mines have been put back into production and new deposits are being explored. Local spokesmen say that the new purchases will mean an additional $500,000 per year for sheet producers.

Magnesite quarry operation near Chewelah, Wash.

General Electric Co. has developed a special insulating use for dry ground mica, consisting of a combination of silicone with fine mica, to be used especially on large direct current motors.

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MONAZITE AND OTHER RARE EARTH MINERALS—A detailed and authoritative report on thorium minerals and deposits was given by C. F. Davidson of the British Atomic Energy Commission in the *Mining Magazine* for April, pp 197-208. This summarizes for the first time thorium resources, particularly those found recently in carbonatites and associated with uranium ores.

Future large scale uses of thorium, for the time being at least, appear to be tied to the success of the breeder reactor in developing atomic power. The metal's use in the atomic energy field is now being tested in two major reactor experiments expected to be completed in 1957 or 1958.

One of the largest monazite areas is in the Boise Basin in Idaho where three operators were working on government contracts until June 1955. Other thorium bearing rocks are the phonolite rocks north of Sundance, Wyo., and the pyrochlore deposits at Okla, Que., and Beaucage and Chewitt, Ont., in Canada.

A chemical plant has been built at Chattanooga, Tenn., to process the monazite produced by Marine Minerals, Inc. Another chemical plant to process monazite has been built at Curtis Bay in Baltimore by Rare Earths, Inc., which is an affiliate of Davidson Chemical.

The bastnaesite deposit at Mountain Pass, Calif., worked by the Molybdenum Corp. of America, contains chiefly cerium, lanthanum, neodymimium and praseodymium, but very little thorium.

●

NITROGEN—A summary of the world situation in nitrogen as it existed on December 8, 1955, is given in *Mineral Trade Notes* for December 1955. This lists production figures for the period 1948 to 1955 and estimates up to 1958. It is interesting that the entire production of Europe as expressed in thousands of tons of pure nitrogen for 1955 was 3747, whereas that of the United States was 2850. Third individual producer was West Germany with 975, while Japan with 645 was fourth; the United Kingdom followed with 480. Chile accounted for only 250.

Chile passed a nitrate referendum approved by the nitrate companies and the government which gives the natural fertilizer a new "lease on life." Harry Guggenheim, chairman of the Anglo-Lautaro Nitrate Co., expressed hope that now he could get a loan from the Export-Import Bank to improve mining and beneficiation methods and to mechanize the loading facilities at Tocopilla. The solar evaporation vats at the Maria Elena plant will be increased from four to ten. These vats are 726 by 660 ft. With increased evaporation capacity, sodium and magnesium sulfates, borates and iodine can be recovered. Most of these are now lost. Glen McCarthy, Inc., has signed a 20-year lease with Anglo-Lautaro Nitrate Co. to supply natural gas from its oil fields to the nitrate mines.

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PERLITE—Perlite, a volcanic glass containing three to four percent occluded water, is mined in Colorado, New Mexico, Arizona, Nevada and California by surface methods. It is

Intermountain Chemical Company's deposit of trona, a basic nonmetallic ore used for the production of soda ash, is located in Wyoming

ground and sized at the mines and shipped as a graded sand weighing 90 lb per cu ft.

When heated, it quickly expands or "pops" to 11 times its original volume. The expanded perlite is a white, vesicular and granular product, weighing from three to 15 lb per cu ft.

There are now 81 perlite processing plants operated by 72 companies in 31 states. The estimated sales of perlite in 1956 were 325,000 tons valued at $2,600,000.

●

REFRACTORIES—The new refractory plant of Kaiser Aluminum and Chemical Corp. at Columbiana, Ohio, was opened in September. The plant has an annual capacity of 48,000 tons of basic brick as well as ramming mixes and furnace grains. The Moss Landing, Calif., seawater plant will increase its capacity to produce periclase (MgO) by installing a new rotary kiln.

The Pennsylvania Geological Survey reports increasing requests for a sand of higher purity than the old stand-by, the Oriskany. The Corning Glass Co. formed a new division called the "Refractories Division."

A refractory paint capable of withstanding temperatures of 1400° F is described in Air Force Report 111,957 and reviewed in the *Journal of Commerce* for April 27.

●

ROCK WOOL—The U. S. Bureau of Mines in its *Report of Investigations* 5203 for March described laboratory results on testing mineral wool raw materials.

●

SALT—The Morton Salt Co. is sinking two shafts at Painesville, Ohio, one for production and the other for handling men and equipment. International Salt Co. has been conducting an extensive program to determine whether salt can be mined under Lake Erie, west of Cleveland. A patent was issued to men of the Allied Chemical and Dye Co., covering a process for recovering pure sodium chloride from an impure brine.

●

SILICA AND INDUSTRIAL SANDS—The Indiana Geological Survey announced that a deposit containing 25,000,000 tons of a high purity silica sand was found in Harrison County. The Ottawa Silica Co. of Ottawa, Ill., has been purchased by the Crystal Silica Co. of Oceanside, Calif. In Washington, the Lyons Hill sandstone deposit near Springdale is producing sand for the plant of the Carborundum Co. at Vancouver, Wash. The Del Monte Properties Co., one of the large sand producers in California, is planning a plant in the northwest.

●

SLAG—The St. Louis Slag Products Co. is processing blast furnace slag from the Granite City Steel Co., producing both hard and lightweight slag. A report on the hydraulic properties of granulated blast furnace slag was given by Taro Tanaka of Japan in *Rock Products* for June and July. The use of fly ash as a building material was described by R. W. Nurse in *Journ. Inst. Fuel Technology*, vol. 29.

●

SODIUM CARBONATE—The story of the discovery, exploration and development of the trona deposit near Green River in Sweetwater County, Wyo., was described by the resident manager of Intermountain Chemical Co., in the July issue of the MINING CONGRESS JOURNAL. The new shaft under development since late in 1955 reached the main mine workings at a depth of 1500 ft in September.

●

SODIUM SULFATE—In north central Washington, sodium sulfate extraction was started at two lakes, ten miles south of Okanogan.

●

STONE—Problems of the stone industries were reviewed by Nelson Severinghaus in *Mining Engineering* for March. Severinghaus pointed out that the granite operations for which he is responsible in Georgia must produce stone to sell at $1.25 per ton, which is about the same price at which the stone sold 25 years ago. Hence the quarry operation must be much more efficient than it was then.

The granite industry of Canada was described in the first complete report in 40 years on that industry in the country. The report was by G. F. Carr and published by the Department of Mines and Technical Surveys.

●

TALC—The U. S. Bureau of Mines issued two reports on investigations in the talc industry: *Report of Investigations 5220* by H. P. Hamlin and T. A. Klinefelter on the properties of reconstituted block talc bonded with magnesium oxychloride; and *Report of Investigations 5241* by D. W. Frommer and M. M. Fine on the laboratory flotation of talc from Arkansas and Texas sources.

At Barrats, Mont., near Dillon, a new talc grinding mill went into operation by the Tri-State Minerals Co., a wholly owned division of Southern California Minerals Co. of Los Angeles. The company owns several deposits in Montana which contain the highest grades of steatite talc.

New York, North Carolina and California are the three leading producers of talc. The United States produces more than a third of the world production; Japan is second, with France a poor third. The largest uses for talc are in ceramics, paint, rubber and roofing, although its use as a carrier in insecticides is growing rapidly.

●

TITANIUM—In this review, we are concerned essentially with the titanium ores used for industrial purposes, principally as a pigment. Although titanium metal is more glamorous, and the ore supplies needed for its production are more critical, the ore used in pigment manufacture is still ten times as great as that used in metal.

At the present time the ores used for pigment are principally ilmenite and the titaniferous slag manufactured at Sorrel, Que., by the smelting of a titaniferous hematite by the Quebec Iron and Titanium Co. Rutile

(Continued on page 160)

1957 Coal Show

Industry set for biggest convention ever

MAY 13-16 are important dates for the mining industry. This is the time for the biennial Coal Show of the American Mining Congress in Cleveland, Ohio. During that week Cleveland will truly be the Mecca for all mining men interested in how to reduce costs and increase production. Not only will many thousands of men who are responsible for producing the coal that builds a better America be there, but miners of metals and industrial minerals will be on hand to see "what's new with coal" and how it might apply to their operations. The latest in mining technology will be thoroughly discussed during convention sessions and the latest in mining equipment and supplies will be displayed throughout the huge exhibition halls and outside exhibit areas at Cleveland's Public Auditorium.

Theme of the year's largest industry affair will be "Coal builds a better America." In recent years our great nation has become more and more aware of the fact that the coal that was so important in winning two World Wars and supporting the police action in Korea is also responsible, in a large measure, for our high standard of living. At the 1957 Coal Show this theme will be expanded to drive home the importance of coal to producer and consumer alike.

Program Tops

The Program Committee, under the chairmanship of A. R. Matthews, president, Pittsburgh Consolidation Coal Co., has left no stone unturned to produce a penetrating and comprehensive program of technical papers which will cover a wide variety of subjects and applications. There will be something for everyone —as a look at the preliminary program on the opposite page will show.

Maintenance and transportation problems will be stressed in the continuous mining sessions. During two conventional mining sessions a wide variety of subjects will be covered including roof support, maintenance, and the application of a-c power. Water clarification will be the principal subject at one coal preparation session while recent developments in equipment will be covered at a second. During two strip mining sessions drilling, blasting and handling overburden will be stressed as well as portable power systems and maintenance methods. At a management and safety session such topics as fire fighting, accident prevention, personnel evaluation and training, and industrial engineering will be aired.

Large Equipment Display

Plenty of time has been left in the schedule of convention sessions to allow thorough study of the wide variety of mining machinery that will be brought to Cleveland. Nowhere else in the world is there such a complete coverage of the myriad of complex machines that go into the nation's coal mines. The large number of foreign visitors, from all parts of the world, is further proof of the great value of the exposition.

Equipment manufacturers will have their ablest technicians present to discuss and explain particular features of each machine. Many a valuable cost-cutting idea has been born in the mind of a coal man as he inspected and compared equipment on the floor of the huge exhibition. Not only will large capital expense equipment be shown, but also the hundreds of maintenance items needed to keep the coal rolling out of our nation's mines.

On the Lighter Side

After a busy day, an evening of relaxation is always welcome and big plans have been made for Cleveland. In addition to the many friendly get-togethers and open houses that are an integral part of any convention, the Coal Miners Party will be held on Wednesday evening. An outstanding evening has been arranged, including fine food, dancing and sparkling entertainment. In the past this great party has taxed the limits of two hotels, and all planning to attend the gala affair should secure their tickets early to make sure they won't be left out.

Another fine program is being planned for the hundreds of ladies who will accompany their husbands to Cleveland. There will be special luncheons and entertainment, which, along with browsing in the many fine shops, will serve to keep them busy while their menfolk are occupied with convention business. As an extra attraction, another boat trip, similar to that of two years ago, has been arranged for Tuesday along Cleveland's impressive lake front and up the amazing Cuyahoga River. Girls, be sure your husbands plan right now to be in Cleveland, and that they bring you with them.

Applications for hotel accommodations in Cleveland have been sent to the industry, but if you have not yet received one, write directly to Louise D. Perkins, Director, Cleveland Housing Bureau, 511 Terminal Tower, Cleveland 13, Ohio. And don't forget to fill in and return the advance registration cards which have also been distributed to the industry. This will save much valuable time in Cleveland.

Preliminary Program

MONDAY, MAY 13

10:00 am—Continuous Mining

Maintenance of Continuous Mining Equipment
J. H. SHERRARD, JR., *Johnstown Coal & Coke Co.*

Design of a Power Installation for a Continuous Operation
W. C. WRIGHT, *Kaiser Steel Corp.*

Current Roof Support Practices with Continuous Mining
ROY D. JOSEPH AND EDWARD M. THOMAS, *U. S. Bureau of Mines*

Roof Support Without Interrupting the Continuous Loading
BENJAMIN TUDOR, *Compass Coal Co.*

TUESDAY, MAY 14

10:00 am—Conventional Mining

Mechanical Mining in Thin Seams
R. M. JOHNSON, *Island Creek Coal Co.*

Underground Rail Haulage Systems
(a) Large Capacity Mine Cars
JOHN R. PALIN, *Harmar Coal Co.*
(b) High Speed Operation
Representative of Powhatan Mining Co.

All-Belt Haulage and AC Power Underground
Representative of DeKoven Mine, Pittsburg & Midway Coal Mining Company

Maintenance—A Tool for Increased Production
Representative of Tennessee Coal and Iron Div., U. S. Steel Corp.

10:00 am—Coal Preparation

Water Clarification—A Symposium to Cover Three Objectives
(a) Recovering Fine Coal of Commercial Value
E. M. ROBINSON, *Jeddo-Highland Coal Co.*
(b) Conserving Water for Re-use
P. L. RICHARDS AND JOHN DURFEE, *Coal Division, U. S. Steel Corp.*
(c) Preventing Stream Pollution
HENRY F. HEBLEY, *Pittsburgh Consolidation Coal Co.*
Other Speakers to be Announced

TUESDAY, MAY 14

2:00 pm—Strip Mining

Drilling and Blasting Overburden
(a) With Ammonium Nitrate Explosives
FRED HORNE, *Peabody Coal Co.*
(b) With Liquid Oxygen
C. C. WOOLSEY, *The Enos Coal Mining Co.*,
D. W. MOGG, *Great Lakes Carbon Corp.*

Overburden Removal
(a) Large Shovel Operations
T. G. GEROW, *Mining Consultant*
(b) Small Shovel Operations
R. E. DOUGHERTY, *Tasa Coal Co.*
(c) Tractors and Scrapers
HARRY H. HUGHES, *J. Robert Bazley, Inc.*

WEDNESDAY, MAY 15

10:00 am—Conventional Mining

Major Factors in Belt Conveyor Haulage
J. W. BASSETT, *West Kentucky Coal Co.*

A Shop for Maintenance Instruction
W. C. SHOTT, *Stonega Coke & Coal Co.*

Special Problems in AC for Underground Power
C. C. CONWAY, *Clarkson Mfg. Co.*

Core Drilling for Airshafts and Manways
D. C. RIDENOUR, *Olga Coal Co.*

10:00 am—Strip Mining

Portable Power Systems for Strip Mining
L. E. BRISCOE, *Ayrshire Collieries Corp.*

New Method for Repairing Large Castings
R. L. RECTENWALD, *Maintenance Engineering Corp.*

Rope Life Extended by Maintenance and Proper Use
B. N. CARLSON, *American Steel & Wire Div., U. S. Steel Corp.*

New Maintenance Ideas—A Compilation of Practices
EMIL SANDEEN, *Pittsburg & Midway Coal Mining Co.*

WEDNESDAY, MAY 15

2:00 pm—Management-Safety

Mine Fire Hazards and Fire Fighting Equipment
J. F. WHITTAKER, *Pittsburgh Coal Co.*

United Mine Workers' Role in Accident Prevention
C. B. FERGUSON, *United Mine Workers of America*

Personnel Evaluation and Training
C. R. NAILLER, *Christopher Coal Co.*

Cost Controls Through Industrial Engineering
G. W. LOCKIN, *Inland Steel Co.*

THURSDAY, MAY 16

10:00 am—Continuous Mining

Service Haulage for Continuous Mining
(a) With Extensible Belt
W. G. KEGEL, *Jones and Laughlin Steel Corp.*
(b) With Bridge, Chain and Belt Conveyor
GORDON GEORGE, *Wyatt Seanor Coal Co.*
(c) With Shuttle Cars
MICHAEL M. O'BRIEN, *Pocahontas Fuel Co.*

Mechanical Mining in Difficult Seam Conditions
RAY M. BIGGS, *Viking Coal Co.*

10:00 am—Coal Preparation

Coal Drying and Dust Collection
A. P. MASSMAN, *Peabody Coal Co.*

Coal Cleaning with the Feldspar Jig
E. R. MCMILLAN, *Northwestern Improvement Co.*

Operating Double Deck Tables
F. S. AMBROSE, *Fairmont Machinery Co.*
D. H. DAVIS, *Mathies Coal Co.*

Modern Cleaning Plant Design
LOY A. UPDEGRAFF, *Bituminous Coal Research, Inc.*

Wheels of GOVERNMENT

AMC

As Viewed by HARRY L. MOFFETT of the American Mining Congress

THE 85th Congress convened on January 3 midst continued tension in the Middle East. Its complexion differs little from that of its predecessor. The Senate is slimly controlled by a 49-47 Democratic majority, as was the case in the 84th Congress, while in the House the Democrats retain control by 33 votes, a slight gain over their previous majority.

There is little doubt that a busy schedule lies ahead for the lawmakers. At this early date over 4500 measures have been dropped into the legislative hoppers, many of them "repeats" of previous years, but a fairly large number representing new proposals. Every segment of industry is affected by these bills.

Departing from the practice of previous years, President Eisenhower's first message to Congress was one in which he submitted proposals to fill the vacuum created in the Middle East by the exit of the British. Then in swift order came his messages on the State of the Union (usually the initial message sent Congress), the budget, and the state of the nation's economic health. Within the framework of these messages the President set forth a legislative program, much of it a renewal of proposals sought in past years, which he hopes to see enacted during his second term in the White House. Sprinkled throughout the messages were proposals which indicate that the President is taking a definite "liberal" approach to national problems. None of the messages gave a hint as to what the Administration is planning to recommend in the way of national mineral policies, but general terms were used to indicate that such policies are approaching the final draft stage and will be sent to Capitol Hill early in the session.

Major Legislation Sought

In his State of the Union message, the President made few recommendations to Congress, saying that details of the legislation he would seek would be contained in later messages. He did, however, repeat for the third year his request that Congress approve U. S. membership in the Organization for Trade Cooperation (OTC). He also called for authorization for full U. S. participation in the International Atomic Energy Agency, and for Congressional authorization to conduct an inquiry into the "performance and adequacy of our financial system."

The President urged business and labor leaders to help guard against inflation, which he termed a serious threat, by avoiding unnecessary price increases and by linking wage increases to improvements in productivity.

His budget message, which calls for a record peacetime Federal budget of $71.8 billion, contained some 99 legislative recommendations. In it he opposed all tax cuts for another year except minor relief for small business. Major proposals of interest to industry would involve: financial aid to help communities in combating unemployment, extension and improvement of unemployment insurance, broadening of the coverage of the minimum wage act, notification to the Federal Government of proposed business mergers, amendment of the antitrust laws to strengthen enforcement provisions, Federal aid for school construction, exemption of issues of securities up to $500,000 from SEC registration requirements, consolidation of wage reporting for income tax and social security purposes, legislation to free natural gas producers from utility-type regulation, authorization for the Government to supplement commercial insurance against liabilities arising from nuclear accidents, extension of authority to sell surplus agricultural products abroad and to barter such products for strategic materials, registration of employe pension and welfare funds to protect beneficiaries' interests, and statehood for Alaska and Hawaii.

In submitting the 1958 budget the President estimated that receipts would provide a surplus over expenditures of $1.8 billion, which he said should be applied to national debt reduction. He expressed the hope that the fiscal situation would be such that no increase would be needed in the present $275 billion national debt limitation.

As to taxes he asked, as expected, that present rates on corporate taxes and certain excises, due to decline April 1, be extended by Congress.

The budget would provide $104 million for mineral resources development and conservation, an increase of $10 million over 1957. It includes a request for $40 million to be made available promptly for carrying out purchase programs for asbestos, tungsten, fluorspar, and columbium-tantalum. An additional request for another $30 million for this purpose was submitted by the President a few days after the budget went to Congress. For stockpiling of strategic and critical materials the new budget provides $245 million, of which $69 million would be used for open market purchases principally from domestic producers. Fairly substantial increases for activities of the U. S. Geological Survey and the U. S. Bureau of Mines were also requested.

The huge budget was challenged by Secretary of the Treasury Humphrey, who told newsmen that it contained a number of proposed outlays that could be eliminated. He said that the present trend of spending must be reversed, and voiced the hope that this

Washington Highlights

85TH CONGRESS: Convenes.
LEGISLATIVE PROGRAM: Outlined by President.
COAL RESEARCH: Subcommittee named.
FREIGHT RATES: Hearings postponed.
L-208 CASES: Supreme Court to review.
INTERIOR COMMITTEE: To launch investigations.
PRICE DISCRIMINATION: Drive on for legislation.
TREASURY REGULATIONS: Protested by mineral spokesmen.

could be accomplished in the fiscal year 1959. He said that there should be a budget surplus sufficient to permit "a fairly respectable cut in tax rates" before one is attempted, and then added "the need is for the whole tax structure to come down." He predicted that if taxes are not cut the nation will "have a depression that will curl your hair."

Coal Research Hearing to Resume

The House Interior and Insular Affairs Committee has again appointed a special subcommittee on Coal Research, and has empowered it to continue the hearings which began last year on this subject. Rep. Ed Edmondson (Dem., Okla.) again heads the committee. Other members are Reps. Wayne Aspinall (Dem., Colo.), Lee Metcalf (Dem., Mont.), Stewart Udall (Dem., Ariz.), John Saylor (Rep., Pa.), William Dawson (Rep., Utah) and J. Edgar Chenoweth (Rep., Colo.).

It is understood that the subcommittee may undertake a series of field hearings beginning in February. Toward the end of last year Chairman Edmondson had announced that field hearings would probably be held in Oklahoma, Pennsylvania, West Virginia, Kentucky, Virginia, Colorado and Utah.

The committee conducted a series of hearings in Washington last July at which a representative of the American Mining Congress testified.

Freight Rate Hearings Postponed

The Interstate Commerce Commission has postponed, for a third time, hearings on requests of Eastern and Western railroads for freight rate increases that would boost shippers' costs a billion dollars annually. The ICC changed a Washington hearing, to permit shippers and others to cross-examine rail officials on projected increases, from February 25 to April 8; shifted a further cross-examination hearing from Salt Lake City to San Francisco and changed the hearing date from March 6 to April 17; and changed the date for final oral argument before the Commission from March 19 to May 1.

Prior to announcing these changes, the ICC received a further petition from the carriers making it clear that they are seeking a freight rate hike of 22 percent above the level that prevailed prior to the "emergency" rate boosts in late December. The "emergency" hikes provided for a 7 percent rise in rates in Eastern territories and 5 percent in the Eastern region, with hold-downs on coal, coke, and certain other commodities. The Commission, at that time, limited increases on coal to 10 cents per ton, on lignite to 5 cents per ton, potash to 50 cents per ton, and phosphate rock to 30 cents per ton.

L-208 Finding Appealed

The U. S. Supreme Court has agreed to review a decision of the U. S. Court of Claims which found that certain gold mining companies were entitled to recover damages resulting from the operation of the notorious L-208 gold mine closing order issued by WPB during World War II.

About a year ago the Court of Claims ruled that six gold producers—Homestake Mining Co., Idaho Maryland Mines Corp., Central Eureka Mining Co., Alaska-Pacific Consolidated Mining Co., Bald Mountain Mining Co., and Ermont Mines, Inc.—were entitled to damages stemming from the WPB order. Several other companies who had sought Court of Claims approval for damages had their cases dismissed by the court.

It is expected that the Supreme Court will consider the gold mines cases during its fall term.

House Interior Inquiries Probable

During the next few months the House Interior Committee is expected to launch a couple of investigations into the administration of laws of interest to the mining industry.

It is understood that Chairman Clair Engle (Dem., Calif.) plans to initiate a study of the administration of Public Law 167 by the Agriculture and Interior Departments. That law, which had the support of the mining industry when under Congressional consideration, provided for multiple use of the surface of unpatented mining claims so long as such use does not interfere with mining and related activities and established a procedure for resolving title uncertainties surrounding dormant, unidentifiable, or abandoned mining claims. It is expected that officials of the two Departments will be called before the Committee to explain how the law is being carried out, and to answer any complaints that may have arisen as to over-zealous administration by regional officers of the Departments.

It is also understood that a second inquiry may be conducted by the Mines and Mining Subcommittee, headed by Rep. Walt Rogers (Dem., Tex.), into the administration of the mineral leasing laws. Committee aides indicate that subjects of this inquiry will include acreage limitations, royalties and bonuses applicable to mineral leases as well as how the leasing procedure is being carried out by the Government. Minerals which are covered by the leasing system are coal, phosphate, potash, oil, oil shale, gas, and sodium.

No dates have as yet been set for either of these investigations.

Pricing Bills Reintroduced

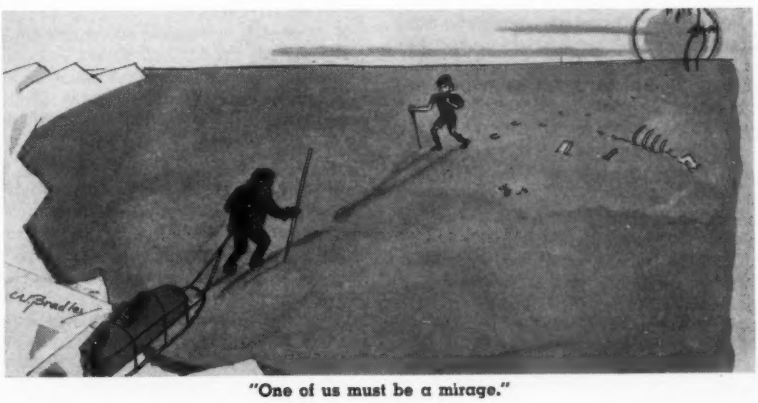
Legislation which would amend the Robinson-Patman Act to severely limit the right of a seller to meet in good faith the lower price of a competitor has been placed before the 85th Congress by Senator Kefauver (Dem., Tenn.) and Rep. Patman (Dem., Tex.), sponsors of similar proposals in the 84th Congress. Most observers believe that this legislation has an excellent chance of passage unless businessmen and industry spokesmen forcefully convey to Congress their views as to its harmful effect.

Last year the House approved such a measure by an overwhelming vote. It did not reach the Senate floor because of a tangled parliamentary situation late in the session.

The pending bills would provide that the showing by a seller that his lower price was established in good faith to meet competition would not serve as a complete defense where the effect of such price discrimination "may be substantially to lessen competition or tend to create a monopoly in any line of commerce."

It is understood that House leaders, anxious to get some bills before the House for prompt consideration, may

(Continued on page 161)



"One of us must be a mirage."

AMC Personals

Edward E. Schwegler has been elected a vice-president of The New Jersey Zinc Co. He will continue as comptroller, the position he has held since 1951.

Schwegler started work at the Company's Denver, Colo., office in 1916, becoming a traveling auditor in 1918. After spending several years in the Accounting Department of the Palmerton, Pa., plant, he was transferred to the New York office, and became chief auditor in 1937. He served as assistant comptroller from 1945 until his appointment as comptroller.

Appointment of **Richard F. Wesner** as new general manager of the Boone County Coal Corp. has been announced. Wesner had been serving as acting general manager since last May, when he succeeded **E. H. Greenwald**, who resigned to join a private engineering firm.

Dr. Eugene Callaghan has resigned as director of New Mexico Bureau of Mines & Mineral Resources to take a position as chief geologist in charge of exploration for Haile Mines Corp. with headquarters in Salt Lake City. He has been succeeded as director of the Bureau by **Alvin J. Thompson.**

Marvin E. Hall has been appointed division superintendent of the Amonate and Bishop mines, of the Pocahontas Fuel Co., according to P. P. Ferretti, general superintendent of mines.

Hall worked for the Fuel Co. from 1921 to 1949, during part of which time he was a foreman at the Amonate and Bishop mines. From 1949 to 1954 he was a Federal mine inspector with the U. S. Bureau of Mines, and from 1954 to 1956 he worked for the Glogora Coal Co. as superintendent. He returned to the Fuel Co. in August 1956 and was employed as a safety inspector prior to his present assignment.

American Potash & Chemical Corp. has announced the promotion of **Henry DeArmond** from assistant treasurer of the company to administrative assistant. DeArmond will report to both Richard J. Hefler, AP&CC secretary and assistant to the president, and Forest E. Branch, director, administrative services.

L. C. Jones has retired as chief engineer of Utah Copper Co., Division of Kennecott Copper Corp., after 48 years with the company. Named chief engineer in 1952, Jones played an important part in converting the Bingham Pit from steam shovel to electrical shovel operations and in developing the ore haulage systems and in engineering four haulage tunnels into the pit.

Z. C. Wagoner, formerly sales manager of Smokeless Fuel Co., has been appointed assistant general sales manager of Carbon Fuel Sales Co. of Charleston.

Two key management changes in Reserve Mining Co. have been announced. **C. L. Kingsbury** is retiring from active business and has resigned as a vice-president of Reserve. **J. William Bryant,** who will assume Kingsbury's duties, has been elected as a vice-president. In his retirement, Kingsbury will continue in a consulting capacity to Armco Steel Corp., joint owner of Reserve Mining Co. along with Republic Steel Corp.

Bryant will continue to serve as treasurer and controller of Reserve.

J. P. Smith, who has served as chief geologist for the United States Potash Co., has been promoted to manager of land exploration for the parent company, United States Borax & Chemical Co.

Announcement of the retirement of two Anaconda Company officials has been made at Butte.

W. E. Mitchell, manager of the reduction works at Anaconda for 16 years, and **John B. Boardman,** chairman of the company's Safety Bureau, retired January 1.

W. A. Emanuel, general superintendent of the reduction plant, succeeds Mitchell who will continue his 45 years of service to Anaconda as metallurgical consultant.

Boardman, who has been with the company 40 years, passed the reins of his job on to **Herbert A. Wendel** who has been with Anaconda since 1927.

James W. Miller, formerly preparation engineer for the U. S. Bureau of Mines and also lecturer at the University of Pittsburgh, has resigned from this work in Pittsburgh, Pa., to join the consulting firm of Robinson and Robinson, Charleston, W. Va., as head of its preparation department.

Lee Messerly resigned January 1 as superintendent of the Hecla Mining Company's Star Mine to join Federal Uranium Corp. as director of mining operations.

Messerly started working for Hecla in 1923 as a miner and worked his way up to mine foreman in 1944 and to superintendent in 1953. He recently directed sinking of the Silver Mountain shaft which set a new record for speed.

Several personnel changes have been announced by the Miami Copper Co. at Miami, Ariz.

Robert W. Hughes, upon completing more than 32 years service with Miami Copper Co. has resigned for reasons

R. W. Hughes

B. R. Coil

of health as vice-president and general manager. **Benjamin R. Coil,** manager, succeeds Hughes as general manager.

At the same time **J. H. Gray** was named assistant general manager; **C. C. Webb** assumed the duties and responsibilities of general superintendent; and **R. P. Hughes** was made chief designing engineer.

Dudley L. Davis has been named general manager of Bay Shore Mining Co., Winslow, Ariz.

After 50 years of service **Robert S. Graham** has retired as attorney and personnel representative of the Kemmerer interests in the South. He was president of the Wallace Coal & Coke Co. and Kemmerer Gem Coal Co. and vice-president of the New York Mining & Manufacturing Co.

Directors of Utex Exploration Co. have named **Mrs. Maxine Steen Boyd** as treasurer of the firm, succeeding **Mrs. Rosalie Shumaker. Charles A. Steen,** discoverer of the Mi Vida mine in San Juan County, Utah, was re-elected president. **W. R. McCormick** was renamed vice-president, and **Mitchell Melich** was reelected secretary. Two other directors renamed were **A. T. Ludlow** and **A. K. McGill.**

Roy E. Dean, assistant to the president of Ayrshire Collieries Corp., Indianapolis, Ind., was elected president of the Indiana Coal Association at its recent annual meeting. He succeeds **David Ingle, Jr.,** president of Ingle Coal Corp.

In a series of moves at The Bunker Hill Co., **Harold E. Lee,** manager of metallurgy for the past year, has been appointed to the newly-created post of vice-president in charge of research and development.

H. E. Lee

At the same time it was announced that **B. F. Mahoney,** who has been manager of the Yellow Pine mine and smelter at Stibnite, Idaho, since 1953 has been named assistant manager of employe and public relations for Bunker Hill. **Arnold S. Souders** succeeds Mahoney at Yellow Pine.

Hubert C. Laird has been apppointed manager of a newly-created mining division of Heavy Minerals Co. As manager of the new mining division, Laird will administer both Coastal Sands and Marine Minerals, the former being a dredging operation on the Gulf Coast, between Panama City and Pensacola, Fla., and the latter a rare earth mining operation near Aiken, S. C.

John L. Wharton has been appointed controller of Glen Alden Corp.

Wharton, who has been assistant controller, succeeds **G. Wilbur Nichols,** who retired as Glen Alden controller December 31, following 46 years of service with the company.

Ralph E. Magnuson, Jr., has been promoted to the position of chief mining engineer for the Cleveland-Cliffs Iron Co. on the Michigan Ranges. He will add the responsibilities of this office to those he already has as administrative assistant to the manager of Michigan mines.

At the same time it was made known that **Daniel Isaacson** has been appointed district mining engineer to assist Magnuson.

The Oliver Iron Mining Division of U. S. Steel Corp. has announced the appointment of **Morris W. Mielke** as assistant general superintendent at Oliver's eastern district operations. Mielke has been active in Oliver's experimental program to define practical ways and means to concentrate and utilize the divisions' reserves of taconite.

David R. Straub has been elected vice-president, general manager and director of the White Pine Copper Co. Straub was project manager at White Pine with the firm which designed the White Pine mine, mill and smelter.

Anthony Mastrovich has been appointed general manager of Climax Uranium Co. succeeding the late **Marvin L. Kay,** Mastrovich, who joined the firm in 1952 as assistant mine superintendent, was assistant general manager of the firm's operation at the time of Kay's recent death.

John G. Connell, Connell Coal Co., Hazleton, Pa., has been appointed a member of Pennsylvania's Coal Research Board, succeeding Edward G. Fox.

Clarence A. Davis has announced his resignation from Government service to open a law office in Washington, D. C. At the time of his resignation Davis was Under Secretary of the Department of Interior, having held that position since September 1954. Before that time he had been solicitor for the Department.

The appointment of **Harold W. Cooper** as employe relations supervisor for the Tralee mine of Semet-Solvay Division, Allied Chemical & Dye Corp., in Southern West Virginia has been announced.

The appointment of **W. G. Jewitt** as vice-president in charge of mines for the Consolidated Mining & Smelting Co. at Trail, B. C., was announced in early December. He had been manager of mines since 1952.

Wilder Beal has been appointed vice-president of Union Carbide Ore Co., according to Fred L. Shanklin, president of this division of Union Carbide and Carbon Corp. Beal started with UCC in March 1937 and has held various positions connected with ore and foreign alloy operations of the corporation. He became manager of construction, engineering and operations in 1956.

Maurice F. Dufour and **Forbes K. Wilson** have been elected vice-presidents of Freeport Sulphur Co. by the board of directors.

Dufour, who joined Freeport in 1933, is in charge of the company's nickel and cobalt interests. Wilson,

M. F. Dufour

F. K. Wilson

who came with Freeport in 1942, is manager of mineral exploration. Both men are also vice-presidents of Nicaro Nickel Co., a wholly-owned subsidiary which is presently planning development of extensive nickel and cobalt deposits at Moa Bay in Cuba.

American Smelting and Refining Co. has appointed **Jackson How** as director of public relations. How, who will supervise an expanded program of public relations activities, joined AS&R January 1.

It has been announced that **John W. Hanley** has been elected a vice-president of Cerro de Pasco Sales Corp.

A. V. Quine has been named general manager of the Lucky Mc Uranium Co. He had been superintendent of Goldfield Consolidated Mines' Deep Creek zinc-lead operations near Northport, Wash.

— *Obituaries* —

Edwin A. Friend, 64, assistant secretary and treasurer of Pittsburgh Consolidation Coal Co., died December 23.

Albert H. Featherstone, 87, president of Golconda Lead Mines, died in Wallace, Idaho, December 15.

The pioneer Wallace attorney had been a prominent figure in Idaho political and judicial circles for many years, as well as in civic and mining affairs. Mr. Featherstone headed the Golconda Lead Mines Co. practically from the time of its incorporation in 1927. He was also a director of Lucky Friday Silver Lead Mines, Clay Silver, and Silver Syndicate, Inc. He served four terms in the State House of Representatives and was in his first term as a State Senator when he was appointed to the bench as a judge of the first judicial district, a position which he held for nearly 30 years.

Truax-Traer Opens Two Mines

A high degree of underground mechanization to obtain maximum production at lowest possible cost is planned by Truax-Traer Coal Co. for two new mines it has opened in Raleigh County, W. Va.

Truax-Traer acquired the property from the Chesapeake & Ohio Railway Co., with reserves in the Eagle and Powellton coal seams estimated for at least 20 years' working life. Princess Dorothy Coal Co., the former operators, extracted the Dorothy and No. 5 Block seams from the property but did not operate in the Eagle and Powellton beds.

Truax-Traer has performed considerable construction work to tap the two coal beds, with a large amount of building yet to be done before full production is attained. The two mines are expected to produce 4000 tpd when peak production is attained late this year.

Before entry development could be launched at the operation, it was necessary to grade roads to both mines from the bottom of the mountain as well as to prepare travelways from the old mantrip hoisting incline to the locations selected for the drift openings. All construction work has been hampered by the very steep mountain slope.

Main entries are being advanced at the two mines by utilizing cutting and loading machines, shuttlecars, and belt haulage. While the entries are being developed and construction of permanent facilities is being completed, temporary arrangements have been made by utilizing equipment from other Truax-Traer mines to convey the coal down the mountainside to a temporary tipple.

While conveyor belts are being used at present in the temporary-facility production of 800 tpd, engineering plans call for installation of track haulage as the mines advance.

The tipple is being reactivated and reconditioned to load run-of-the-mine coal into railroad cars for shipment to the central cleaning plant of Truax-Traer Coal Co. at Ceredo, W. Va.

Joint Titanium Operation

Allied Chemical & Dye Corp. and Kennecott Copper Corp., New York, recently announced their decision to form a new company to produce and sell titanium metal. Plans for the new metal company call for an initial investment of $40,000,000 and further expansion as industry demand develops. The new company will be equally owned by the parent corporations.

A new plant will be constructed, and production of titanium tetrachloride, titanium sponge and titanium billets is expected to start late in 1958.

A new continuous process developed by Allied Chemical's Solvay Process Division, in which sodium is used to reduce titanium tetrachloride to titanium sponge, will be employed. Allied Chemical has also developed an improved process for the manufacture of titanium tetrachloride which permits the use of titanium slag as the raw material.

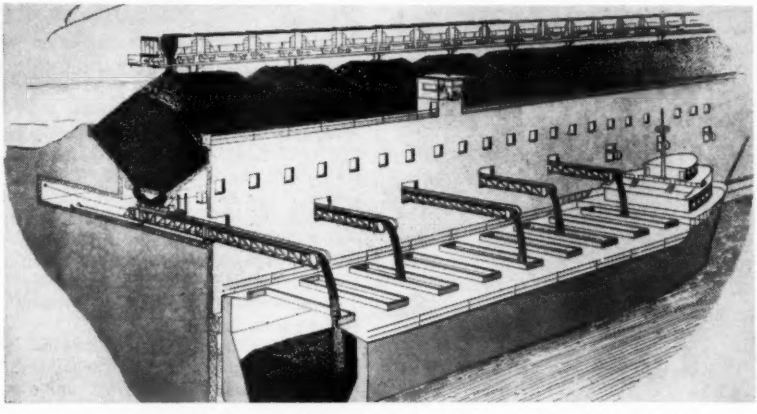
A Kennecott subsidiary, Chase Brass & Copper Co., Inc., has developed processes for melting and fabricating titanium, and these will be employed in the new operation. The new company is expected to undertake further pilot-plant work and market development of an iodide process for the production of titanium with special properties.

The new corporation will be separate from Quebec Iron & Titanium Corp., partly owned by Kennecott, which mines and processes iron-titanium ore to produce pig iron and titanium slag.

Complex Vessel Loader

A new system of 25 shuttle belt conveyors, the first of its kind ever used to load Great Lakes ore vessels, will load taconite pellets at Erie Mining Company's Taconite Harbor, Minn., port facility on Lake Superior when it begins operations. The belt conveyor system permits the loading of as many as 10 alternate hatches simultaneously, a departure from the conventional loading of vessels by chutes. The announcement was by Link-Belt Co., designer and builder.

Two vessels can be loaded simultaneously and the complete system of shuttle belts for each vessel is operated from a central control tower. As shown in the cutaway drawing, the pellets arrive at the dock in rail cars, are emptied into a storage bin and weighed as they are loaded into hatches. Each of the 25 shuttle belt conveyors on the 1200-foot-long dock is capable of loading taconite pellets at the rate of 750 or 1500 long tons per hour at belt speeds of 250 or 500 fpm.



Federal No. 1 To Install Skips

Improvements at the Federal No. 1 mine at Grant Town, W. Va., of Eastern Gas and Fuel Associates, which will increase production by 25 percent, have been announced by H. John Harper, vice-president of Eastern in charge of mining operations.

Work has started on a 267-ft shaft from the preparation plant to the working level of the Pittsburgh seam. It will be located near the present main hoisting shaft.

When improvements are completed, in about a year, the mine will be able to produce 2500 tons of coal a day more than the present production capacity of 10,000 tons a day.

A skip-hoisting system will be installed in the new shaft instead of self-dumping cages as in the present hoist.

Plant Begins Operation

Heavy Minerals Co. has completed construction of its Chattanooga, Tenn., plant and production is now under way. Approximately 150 persons will be employed at the plant in its initial stages of operation, producing thorium oxide used in the atomic program, oxides used for polishing lenses, and fluorides and chlorides.

Rotary Kiln Installed

Columbia Cement Division of Pittsburgh Plate Glass Co. has placed in operation a 450-ft long rotary kiln at its East Fultonham, Ohio, plant. The kiln is a key unit in Columbia Cement's multimillion dollar program for expansion of cement production capacity.

The new facilities have increased the plant's capacity by 50 percent, or approximately 1,000,000 bbl per year.

The company believes the new electronically controlled facilities are perhaps the closest to a completely automatic production plant in the cement industry.

The kiln's dead weight is more than 4,500,000 lb. Because of the steel strike last summer, the kiln was fabricated in eight sections on the West Coast. The units were so large that only one railroad had sufficient clearance along its right-of-way to move the machinery to its Ohio location.

Heshbon Mine Purchased

Pennsylvania Coal & Coke Corp., a division of Penn-Texas Corp., has purchased the Heshbon Coal Co. and the Hillside Store Co. The Heshbon coal mine, located in Indiana County, Pennsylvania, will be reopened soon, with plans calling for the eventual employment of 60 to 75 men. The new owners expect to market about 1000 tpd from this mine.

W. Va. Leaders Looking For Engineers

In an effort to attract more young men and women into the engineering and technical fields, major industry leaders in the Bluefield, W. Va., area recently formed the Pocahontas Industrial Council for Education. The council's announced aim is to induce and aid prospective engineers to enter the profession in an effort to keep a flow of engineering graduates available to area industries.

William Fullarton, special assistant to the president of the Pocahontas Fuel Co., Inc., is serving as chairman of the steering committee.

The council is backed by the major railroads serving the area, the coal industry, electric utilities, wholesale distributors, manufacturers, schools, banks and universities. The area it serves includes Mercer, McDowell and Wyoming Counties in West Virginia and Bland and Tazewell Counties in Virginia.

Kentucky Mine Closes

One of the oldest coal mines in the Williamson field, the Leckie Collieries Co. operation at Aflex, Ky., has been worked out and closed. Coal had been taken from two seams, Alma and Thacker, both of which are now exhausted.

At one time the mine employed more than 200 men and had daily production of 2250 tons. When it closed the payroll was down to 42. The Aflex mine was opened in 1916.

Federal Study Grant

Occupational requirements of West Virginia's coal industry will be studied under a Federal grant from the U. S. Department of Labor, with the Industrial Relations Institute of West Virginia University conducting the study in two southern West Virginia communities where economy is dependent completely on the coal industry.

The study is planned to determine recurring demands for new workers in the industry and will list specific breakdowns in educational, skill and physical needs of each job, as well as the number of new workers needed each year.

Information gained through the study will be used in planning school curricula in mining areas.

Vitro Enters Manganese Field

Formation of a new company to produce manganese from domestic ores, and the award of a contract from the General Services Administration to pilot a process for such production has been announced by J. Carlton Ward, Jr., president of Vitro Corporation of America.

Joining in the announcement were Philip H. Sellew, president of Sheer-Korman Associates, Inc., and Albert M. Garbade, president of Great Divide Mining and Milling Corp.

The GSA contract, extending 19 months and totaling $270,541, was awarded to Vitro Laboratories Division, which will equip, operate and maintain the pilot plant in its West Orange, N. J., Laboratory to develop the economic factors for full scale production by the Sheer-Korman high intensity arc process of metallurgical-grade manganese from rhodonite.

The new company, U. S. Manganese Corporation, recently incorporated in Delaware, is owned 40 percent by Vitro; 40 percent by Sheer-Korman, which has supplied its processes and patents; and 20 percent by Great Divide, whose deposits will supply the rhodonite ore for production.

Mount Hope Mine Sold

The Mount Hope Coal Company's modern mechanized Sterling Sewell mine at Holcomb, W. Va., has been sold to Sycamore Coal Co. The purchase brought Sycamore's holdings to five mines in West Virginia, Virginia and Kentucky, all of which are operated from company headquarters in Huntington.

In the purchase of Mount Hope's mine at Holcomb, Sycamore obtained reserves in excess of 10,000,000 tons of high-quality, low-volatile Sewell seam coal.

Mount Hope had operated the Sterling Sewell mine since 1943. Production totals about 1200 tpd and employment has averaged 150 men.

Ilmenite Ore Find

New Jersey state geologists have confirmed the existence of a rich ilmenite ore body in South Jersey. Detailed examination of samples from three boreholes and visual inspection of samples from 11 others, according to a State geologist, indicate a high ilmenite content throughout the belt examined so far.

Mine Changes Hands

Simpson Coal & Chemical Co., which operates mines in three States, has taken over the Wood Pocahontas Mining Co. mine at Besoco, W. Va. The Simpson firm acquired 100 percent of Wood Pocahontas stock.

New officers of Wood Pocahontas Mining Co., which will maintain its corporate identity, will be headed by Paul Bock as president. Other officers are C. A. Goldschmidt, vice-president, Karl J. Schumer, secretary, and Alfred A. Adrian, treasurer.

Wood Pocahontas operates in the Pocahontas Nos. 2, 3, and 6 coal seams, averaging 48 in. thick on the property. It has been producing about 800 tpd, but the new owners plan to mechanize the mine and increase output to 2000 tpd.

Total reserves for the Wood Pocahontas mining operation are approximately 15,000,000 tons, with the new owner having leased an additional 2500 acres in the Pocahontas seams.

Peabody Buys Poplar Ridge

The sale of the Poplar Ridge Coal Co., a subsidiary of Union Electric Co. of St. Louis, is reported to Peabody Coal Co.

Poplar Ridge operates a slope mine at Sturgis, Ky., producing about 800,000 tons of coal annually and holds mineral rights on mines containing reserves of about 100,000,000 tons of coal. Union Electric began work on a second Poplar Ridge mine last year near Clay, Ky., but it was suspended pending completion of the sale.

Industrial Minerals

(Continued from page 149)

is the raw material used for the manufacture of titanium tetrachloride (the starting material for titanium metal) by all but one of the larger metal manufacturers. That one uses the weakly-magnetic fraction of the titanium minerals in the Florida sand deposit called Trail Ridge.

Improvements in the supply situation resulted from the following developments. Metal and Thermit Co. purchased an 800-acre tract five mi west of Montpelier, Va., and is constructing a plant to produce 10,000 tons of rutile annually. National Lead Co. announced a 25 percent expansion of its ilmenite mine and mill at Tahawus, N. Y. A large but low grade deposit of ilmenite and rutile was discovered in Sierra Leone, just below the confluence of the Mabole River, near Port Loko. This deposit of rutile and ilmenite in clay and sand from an ancient marine sediment may hold several million tons of rutile and ilmenite. The deposits are being explored by British Titan Products Co. and Columbia Southern Chemical Corp. Deposits of fossil stream placers in sandstones near Escalante, Utah, and Gallup, N. M., were under exploration, but the titanium mineral is very fine and may be difficult to recover. In November the state geologist of New Jersey announced the discovery of old river bars containing concentrations of titanium minerals in Ocean Country, N. J., close to several pigment manufacturing plants. Interestingly enough, the ilemenite has weathered sufficiently so that enough iron has been leached out to yield analyses of the clean ilmenite up to nearly 60 percent TiO_2. Unfortunately the belated discovery found the area subdivided and built up for residential and public purposes.

Active exploration is still under way at the deposits of rutile in Oaxaca, under development by Republic Steel Co. ●

VERMICULITE—The Zonolite Co. completed its processing plant near Lanford in Laurens County, S. C., some 35 miles southeast of its original plant at Travelers Rest in Greenville County. The material in Laurens County is of lower grade but can be concentrated in the new plant.

The Vermiculite Institute of Chicago prepared a revised edition of its booklet *"Standard Specifications of Vermiculite Acoustical Plastic."* Developments in manufacture and use of vermiculite in high temperature insulation were described by J. Hitner in the *Bulletin of the American Ceramic Society*, pp. 147-150. ●

ZIRCON—Most of the developments with zirconium are concerned with the

metal, and with the manufacture of carbides and borides, discussed under ceramics and refractories.

The use of zircon sand as a sand casting mold material has been known for several years. If the results in the production of smooth castings that need no further dressing are as important as they have been described, it seems surprising that more zircon is not used by foundries, in spite of its much higher cost. Now the National Supply Co. of Pittsburgh, Pa., announces that it intends to push the use of zircon for this application. They claim that castings up to 30,000 lb in weight have been made successfully in zircon foundry sand. Molten iron does not "wet" zircon, and hence does not incorporate a lot of the sand into the outside of the casting.

In Zirconia refractories the difficulty caused by the change in volume from the monoclinic to the tetragonal form at about 1000° C has been mentioned in these pages in previous years. Several papers discussed this problem during the year.

Wheels of Government

(Continued from page 153)

press for early action on the Patman measure.

Last year, Julian D. Conover, executive vice-president of the American Mining Congress, in testifying on similar bills, warned that approval of such legislation would throw doubt and uncertainty into a broad field of lawful and long-accepted pricing practices which actually insure competition and inure to the benefit of the consumer.

Treasury Regulations

Early in January, spokesmen for the mining industry outlined to the Internal Revenue Service their objections to and recommendations for changes in the proposed regulations under the natural resources provisions of the Revenue Code.

Chairman Henry B. Fernald of the American Mining Congress Tax Committee opposed any departure from the long-established standards and procedures for computing "gross income from the property," and any abandonment of the present method for determining the depletion allowance. He recommended a number of changes in the depletion provisions of the proposed regulations to bring them more in line with the intent of Congress.

Fernald was joined by AMC Tax Committee vice-chairman Lincoln Arnold in urging several amendments to the proposed regulations dealing with aggregation of mineral properties for depletion purposes, and with exploration and development expenditures.

New Ohio Coal Mine

North American Coal Corp. is planning to develop within the next two years a new $10,000,000 coal mine and possibly reopen another near Clarington, Ohio. The new project will tie in with a proposed Ohio Power Co. plant there.

The tract upon which the new mine will be located contains 17,000 acres of virgin coal. The mine will be known as Powhatan No. 4, and will require the construction of new buildings and equipment, which will be of the most modern design. The tract contains an estimated 85,000,000 tons of coal.

It was also made known that Powhatan No. 2 mine at Powhatan, Ohio, will be reopened when the need arises.

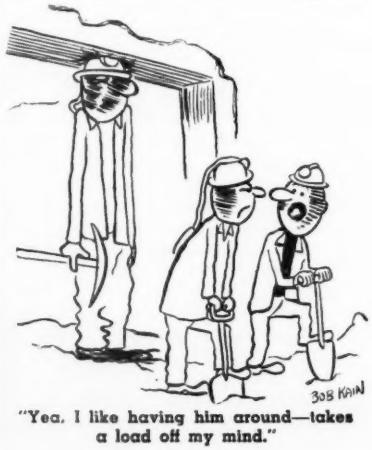
Black Eagle Mine Sold

The 1500 tpd coal mine of Jones & Laughlin Steel Corp. at Black Eagle, W. Va., has been purchased by Pittston-Clinchfield Coal Corp. The transfer of ownership became effective on January 1.

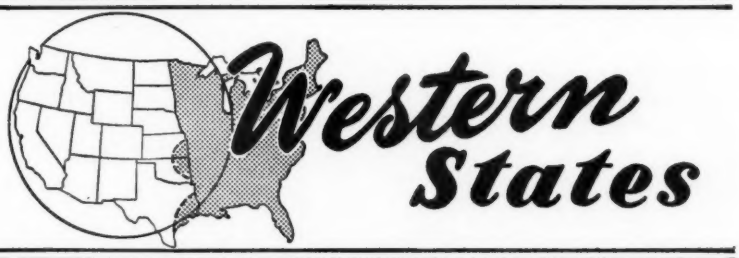
The mine will be operated by Amigo Smokeless Coal Co., a subsidiary of Pittston-Clinchfield. Amigo officials said there would be no change in personnel at the Black Eagle operation.

To Build Coal Dock

Peabody Coal Co. has announced its intention to build a 1687-ft loading dock at its marine terminal at East St. Louis, Ill. The dock will accommodate 19 barges at one time, nine loaded, one loading, and nine empty. Planned for completion in 1957, the dock will be equipped with barge shifting mechanism and a pivoted coal loading conveyor boom to allow for fluctuation of the river level. Coal will be transported by conveyor belt 288 ft from a hopper on shore to the loader. Provision has been made for extending the dock approximately 400 ft in each direction and for adding additional cells, should the need for future expansion arise.



"Yea. I like having him around—takes a load off my mind."



Cripple Creek Gold Tapped

Bonanza gold ores now are being extracted from the Cripple Creek-Victor mining district, according to John Deerkson, president, Front Range Mines, Inc.

Front Range and Golden Cycle Corp. are jointly tapping the celebrated Bobtail vein which was discovered in 1893. The ore is being reached through a tunnel started in 1950 that is being driven by Golden Cycle. The tunnel, on the 3100-ft level, now is more than 2500 ft long and underlies the high school and ball park in Victor. It will open up the hidden values of the Strong and Independence mines, and claims of United Gold Mines Co. and Mary Cashen Development Co. The ore is being taken out through the Ajax shaft, a Front Range property.

Deerkson said that the current operations on Bobtail are the most important development in the district since the discovery of Cripple Creek, with exception of the driving of the Carlton drainage tunnel which makes the work possible. He said that Cripple Creek would be booming today if sufficient labor were available.

Uranium and Hotel Business

Golden Crown Mining Co. of Arizona has purchased the Grand Canyon Inn. It acquired the 20-acre resort to expand its adjacent uranium mining operation and will operate the hotel as a subsidiary.

Change to Solvent Extraction

Texas-Zinc Minerals Co., an affiliate of the Texas Co. and the New Jersey Zinc Co., has switched to the solvent extraction process in the new multi-million dollar uranium mill under construction at Mexican Hat, San Juan County, Utah. A. L. Hayes, Grand Junction, Colo., general manager for Texas-Zinc, said the switch from resin-in-pulp to solvent extraction was made because of probable greater economies. The new mill, estimated to cost in the five to seven million dollar range, is scheduled to go on stream late in 1957. Hayes said that a buying station is expected to be placed into operation at Mexican Hat serving the Monument Valley district during January.

Isbell Construction Co. of Reno, Nev., is currently working on construction of a new 40-mile-long road. This new entranceway into White Canyon is expected to be completed by Isbell in early spring, Hayes said. By the time the road is finished, the sampler and crusher at Mexican Hat should be operative.

Hayes reported that slightly more than 100 persons will be employed on a three-shift basis at the Mexican Hat concentrator. Housing for 65 permanent employes and their families is being erected.

Montana Iron Ore Lease

The Montana State Land Board has assigned a Teton County iron ore mining lease to a Duluth, Minn., corporation, the Winston Brothers Corp.

Increase In Copper Output Planned

The Anaconda Co. will increase its production of copper in the United States by 44.5 percent by 1961, according to company plans. Anaconda, the third largest U. S. producer of copper, turned out 124,016 tons in 1955.

While visiting Anaconda's properties in Chile, Board chairman Roy H. Glover announced that Anaconda now has under its control ore reserves that are unsurpassed by any other entity in the world. He said the company has spent $350,000,000 during the past ten years for development of new properties and increased production in its several operations. In the next five years, he added, Anaconda expects to at least equal this expenditure.

Sulphur Firm Grows

The one millionth ton of sulphur was produced in December from Pan American Sulphur Company's Jaltipan Dome in Vera Cruz, Mexico, according to Harry G. Webb, president.

Pan American, the largest sulphur producer in Mexico, exported in excess of 400,000 tons of sulphur during 1956. Current production is at the rate of 2000 tons a day.

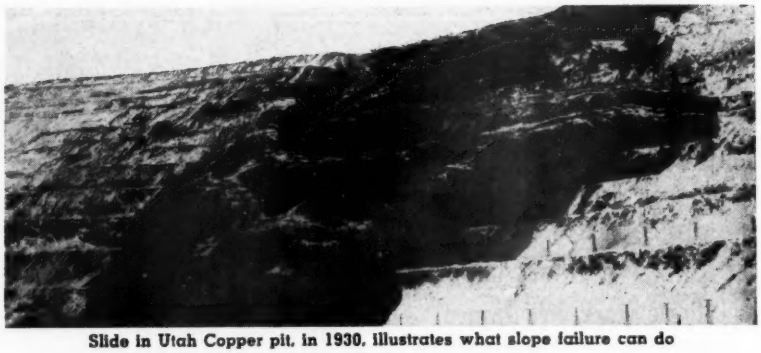
Open Pit Mining

(Continued from page 66)

2000 or even 3000 ft the effect of a very few degrees difference in slope is serious.

Kennecott's Utah Copper Division pit at Bingham Canyon peaks at 2000 ft above the present pit bottom and will ultimately be much greater. A difference of 5° in the ultimate slope angle equals 80 million tons of stripping in only one area of this pit.

The practical miner has much to his credit in successfully designing ultimate pit slopes, but failures have occurred, and, where none have, there is the question on whether a given pit could have been finished to a steeper slope with consequent saving in stripping. He has learned, for example, that reducing the size of blasting charges for the final pit cut to minimize back break will leave a much more stable and firm pit face. Blasting care at this stage of operation will increase blasting costs, but will pay out in reduced stripping with steeper final slopes. Several believe that augmenting practical experience with scientific knowledge of soil and rock mechanics may point the way to a less empirical approach to the problem of slope stability in rock structures.



Slide in Utah Copper pit, in 1930, illustrates what slope failure can do

Extensive research work has been done over a period of many years in rock mechanics applied to underground openings. Soil mechanics, a long established scientific tool in determining safe slopes for earth fills, dams, etc., has also been applied to rock failures in underground mines. Canadian engineers have been particularly active in this field. Considerable interest of more than speculative nature has developed for applying soil and/or rock mechanics to the problems of determining the stability of rock slopes in open pit mines. Of particular value would be the development of scientific tools and calculations to predetermine the maximum, safe ultimate pit slope before reaching the final pit perimeter. The many variables of fractures, chemical action, moisture content, permeability, time, etc., complicate the problem.

Several soil mechanics, engineering and consulting firms, at least one university and the United States Bureau of Mines have been approached on

such a project by at least one major mining company.

During 1956, the Bureau established cooperative agreements with several copper, iron, and molybdenum mining companies to conduct research on the mechanics of block caving. The mechanics of stability of rock slopes, particularly in the deeper open pit mines, appear similar to those of block caving and the study will probably be broadened to include them. Developments of this study will certainly be closely watched by the open pit mining industry, particularly the operators of the large pits.

Acknowledgment for assistance in preparing this review is made to the operators contacted by the author and to information gained from the technical literature published during the year.

Cement Companies Merge

Directors of Lone Star Cement Corp., New York, and Superior Portland Cement, Inc., Seattle, have approved the acquisition of the assets of Superior by Lone Star in an exchange of stock valued at over $16,000,000, subject to the approval of Superior stockholders at a special meeting.

Lone Star operates 12 plants serving most of the area east of the Rocky Mountains and has six plants in Latin America which are operated by foreign subsidiaries. The acquisition will extend Lone Star's operations to the Pacific Northwest for the first time, and the company plans to expand Superior's capacity and marketing territory in the Northwest and Alaska.

Phosphate Project Begins

A $10,000,000 phosphate project of the Central Farmers' Fertilizer Cooperative of Chicago has begun with rough grades for a railroad and access road in Georgetown Canyon, 15 miles north of Montpelier, Idaho. The mining and milling operation will have a daily output of 1500 tons of processed ore, with production scheduled to start sometime in 1958. Work has begun 1½ miles from the canyon mouth, through private land and across the national forest boundary and will continue on to the plant site, located near the company's 2400-acre phosphate deposits to be mined by open-pit methods.

An electric-arc furnace will be used in the reduction of phosphate ore.

Oliver Has Longest Iron Ore Season

Oliver Iron Mining Division late in December rang down the curtain on the longest ore season in its 64-year history, shipping over 30,000,000 tons of iron ore and concentrates.

The 1956 season of the U. S. Steel subsidiary was hampered by the steel and shipping strikes which lasted 70 days during mid-summer, but the Division's 6700 miners partially made up for the production lost last summer.

Included in Oliver's 1956 Minnesota ore production were over 5,000,000 tons of high-grade iron ore concentrates produced from taconite and other low-grade ores. Seven beneficiation plants produced the concentrates from crude ores mined chiefly on the Western Mesabi and from taconite quarried at Mountain Iron.

Oliver's miners are currently overhauling mining equipment and plants and getting the mines ready for the 1957 ore shipping season by removing 24,700,000 tons of overburden.

Early last year Oliver announced it would construct or install ore-sizing facilities at six Mesabi range locations, including four ore concentrating plants. The units will be in operation this year.

1957 Mining Convention— Metal Mining and Industrial Minerals

A. H. SHOEMAKER, general manager, Homestake Mining Co., Lead, South Dakota, has accepted appointment as National Program Committee Chairman for the 1957 American Mining Congress Convention to be held in Salt Lake City September 9 to 12. Mining industry leaders representing all mineral producing areas will work with Chairman Shoemaker to develop a comprehensive convention program. As with past AMC programs, it will bring out the status of the various branches of the mining industry in relation to our domestic economy and mining's views on Federal policies which affect it. The latest methods and equipment being applied in the extraction and processing of metallic ores and industrial minerals will be fully presented. The convention will provide a broad exchange of views between industry representatives and Government officials at all levels and will attract thousands to Salt Lake City —the crossroads of western mining.

An enjoyable schedule of social events is being arranged for the mining men and their ladies, and trips to mines and plants in the Salt Lake area will provide a real opportunity to see some of the nation's most modern mining and metallurgical operations.

A. H. Shoemaker

L. F. Pett, general manager, Utah Copper Div., Kennecott Copper Corp., who was elected chairman of the Western Division of the American Mining Congress at the last Board of Governors meeting, is taking an active part in the coordinating of all convention arrangements, and promises a top-notch meeting.

Hotel reservations will again be handled by a Housing Committee, and reservation blanks will be mailed out to the industry shortly. Reservations may also be requested directly by letter to the Housing Bureau, Convention and Visitors Bureau, P. O. Box 329, Salt Lake City, Utah.

Sets Safety Record

The Los Angeles plant of American Potash & Chemical Corp. recently completed three years without a lost-time accident—the longest no-accident record ever set by one of the company's facilities.

Company officials attributed the safety record to the American Potash safety education program, safety-promoting activities of the plant union, and a modernization plan at the Los Angeles plant. Weekly safety education meetings have been held at the plant for more than three years, at which it is stressed that most accidents are caused by human failure rather than mechanical failure. A coordinated effort also has been made by plant management with the plant union through which safety committees conduct frequent inspections for industrial hazards.

Alaska Juneau Diversifies

Alaska Juneau Gold Mining Co. has acquired as a subsidiary Reynolds Manufacturing Co. of Springfield, Mo., maker of tandems for trucks, buses and tractors and fabricates of structural steel for bridges and heavy construction. Price paid for all the stock of the Springfield concern was $2,750,169 of which $1,500,422 was cash and the balance in ten-year five percent notes.

This is the first development announced by Alaska Juneau since new management took over last June and moved the company headquarters from San Francisco to Los Angeles.

Geologists Use Helicopters

A 51-man survey party equipped with helicopters mapped the geology of some 28,500 sq miles of mineral-rich territory in British Columbia last summer. It was estimated that geologists traveling by horse, canoe and on foot would have taken about 20 years to do the same job.

The task, accomplished by a party headed by Dr. Ernest E. Roots, geologist, paves the way for the opening of mining development in the Cassiar Mountains and the Stikine Plateau of northern British Columbia.

The party worked in the remote, uninhabited area for 166 days, producing the first maps of its geology and mineral possibilities. It was able to cover the region by using two helicopters to supply and move survey groups to various sites from a central base in the Dease Lake area, some 120 miles south of the Yukon boundary.

Dr. Roots said that preliminary geological maps showing types of minerals most likely to be found in specific sections of the territory will be available to mining companies and prospectors next spring.

The survey party, which included 17 geologists and technical officers of the Federal Mines & Technical Surveys Department, was the first in Canada to use helicopters for large-scale mapping of mountainous country. The party was split into seven groups which studied the geology of areas previously photographed from the air by the Royal Canadian Air Force. These aerial maps gave some clues to the areas where minerals would likely be found.

Dr. Roots said the expedition's work encourages the belief that northern B. C. is a treasure house of minerals. "We now can put something fairly reliable on a geological map," he said. "The map won't pinpoint mineral deposits but it will show the mineral potential of various areas and what mining companies may expect to find." Geological survey parties will return to the area during the next few years to make more detailed maps.

Open Wyoming Buying Station

A provisional uranium ore-buying station has been opened by the Atomic Energy Commission at Crooks Gap, Fremont County, Wyo. The station, to be operated for the Commission by Lucius Pitkin, Inc., will provide a market for Gas Hills and Crooks Gap ores amenable to the Lost Creek plant. These ores will no longer be purchased at the Riverton, Wyo., buying station. Other acceptable ores tributary to Riverton will for the time being continue to be bought at that station.

The provisional buying station will operate at Crooks Gap until permanent automatic sampling facilities are completed by the Lost Creek Oil & Uranium Co. sometime in the spring of 1957. Lost Creek also is building a uranium processing mill on the site. The permanent sampling plant will be leased to the Commission by Lost Creek until the processing mill is completed, at which time Lost Creek will take it over to purchase ores for their own account.

Because of the provisional nature of the buying station, uranium ores will be received only from producers who have negotiated contracts with the Commission. No trial lots will be accepted at Crooks Gap, and new producers wishing to negotiate a contract should contact the Grand Junction Operations Office.

Acquires Uranium Claims in Utah

Union Carbon & Carbide Corp. has announced acquisition of various uranium claims in the Temple Mountain area under lease to or owned by Consolidated Uranium Mines, Inc. of Salt Lake City.

The properties will be opened by contractors for the production of ore for Union Carbide's new concentrating plant at Green River, which is expected to be in full operation during the second half of 1957. Final milling operations will be at Rifle, Colo., under Carbide's recent contract with the Atomic Energy Commission.

Uranium Oxide Has Doubled

The Atomic Engery Commission has reported the rate of United States uranium oxide production has doubled in less than a year. United States mills currently are producing at an annual rate of more than 8000 tons of uranium oxide, compared with 4000 tons at the beginning of the year, the AEC said.

Uranium oxide is a concentrate that may be refined into metal for nuclear reactors or into chemicals for gaseous diffusion plants.

The United States, Britain and Canada announced in December they will release much information on nuclear power techniques and resources heretofore kept secret. The first outgrowth of the new policy was the report on uranium oxide output. It was accompanied by an estimate that the United States had 60,000,000 tons of uranium ore reserves as of Nov. 1.

Of these reserves, 68.4 percent were in New Mexico. The rest were distributed percentagewise as follows: Utah 12.5, Colorado 6.8, Arizona 4.3, Wyoming 3.8, Washington 2.5 and all other states 1.7.

The information was given out simultaneously with an estimate in Ottawa that Canada has 225,000,000 tons of known reserves of ore.

Frisco Mine Closes

The Frisco Mine, second oldest mining operation in the Coeur d'Alenes, was shut down permanently December 31, according to J. C. Keiffer, manager of the Northwestern Mining Department, American Smelting & Refining Co. "Circumstances beyond our control" forced the shutdown, he said.

The property was located in 1884 and had produced 1,000,000 tons of ore by 1906. Federal Mining & Smelting Co., predecessor of A. S. & R., acquired it in 1912.

Homestake Into New Mexico

The Atomic Energy Commission has announced the signature of a contract with a partnership led by Homestake Mining Co. for erection of a 750-ton-a-day uranium mill near Grants, N. M.

Participants in the Ambrosia Lake district program with Homestake include Rio de Oro Uranium Mines, Inc., United White Weld & Co., San Jacinto Petroleum Corp., Western Minerals Co., J. H. Whitney & Co. and Clyde Osborn.

The new plant will use an alkaline leach process, according to D. H. McLaughlin, Homestake president. McLaughlin estimated ore reserves behind the mill at 1,000,000 tons.

Meanwhile, Homestake announced that it has entered into a limited partnership agreement with Sabre-Pinon Corp. for mining Sabre-Pinon properties in the area. McLaughlin said the agreement gives Homestake a 25 percent interest in all profits, and complete management of the mining and milling operations. The new partnership will be known as Homestake Sabre-Pinon Partners.

Metaline Map Released

A preliminary geologic map of the Metaline mining district in northern Pend Oreille County has been released by the United States Geological Survey. The map shows geology of a 75-square-mile area containing economically important deposits of zinc and lead. It is accompanied by a topographic map and an explanation sheet. Interested persons may inspect the material at the agency's Spokane office.

Canadian Steel Plant Planned

Western Canada Steel, Ltd., has announced purchase of a 140-acre island in the Fraser River opposite Vancouver, and is planning a basic steel smelting plant that would serve Vancouver and the lower mainland of British Columbia. Pending a start on the smelter, the company will start immediate construction of a $2,000,000 steel ingot plant with a 100,000-ton capacity.

Construction on the smelter will begin as soon as sufficient deposits of iron ore are proven at an undisclosed tidewater location near Vancouver.

Within 60 days the company will start construction of a private steel swing-span bridge, 800 ft across the Fraser River channel. In addition, it will build docking facilities for 5000-ton ore-carrying ships.

The announcement said the company "already owns several deposits of ore in tidewater close to Vancouver." Prolonged tests have shown that they lend themselves to electric smelting, but more exploratory work must be done to prove sufficient ore for long-term smelting operations.

Cement Plant Construction Begins

Ideal Cement Co., Denver, began construction last month on a new 1,500,000 bbl annual capacity plant costing about $14,000,000 at Ada, Okla. The initial contract, of about $6,000,000, covers erection of buildings and installation of kilns, mills and other machinery already purchased and at the site.

It is estimated that construction of the new plant will take 300 days. Upon completion it will bring Ideal's capacity at Ada up to 3,700,000 bbls a year. Ideal presently has a 2,200,000 bbl plant in operation at Ada.

Wah Chang Acquires Tin Smelter

In early January the Federal Facilities Corp. announced that it had signed an agreement with Wah Chang Corp., New York, for the sale of the Longhorn Smelter and other assets of the Government's tin program at Texas City, Tex., to Wah Chang. The Government also announced that Wah Chang has advised that it expects to make substantial capital expenditures to adapt part of the plant to tungsten operations and the manufacture of tin alloys, and that a substantial portion of the facility will be maintained for the smelting of tin, subject to economic considerations.

Wah Chang said in a statement issued later that the remodeling and changeover of the smelter facilities will require time, and that the smelter operation will be discontinued until modification and changeover of the facilities have been completed.

To Explore Wyoming Iron Ore

Columbia-Geneva Steel Division of United States Steel Corp. has announced that contracts are being completed for exploratory development of iron ore deposits in the South Pass area of southwest Wyoming. The contract is being negotiated with Centennial Development Co. of Eureka, Utah, and will call for excavation of an adit and for exploratory drilling.

Reserves in the South Pass deposits are unknown—the completing of reliable reserve estimates being one of the main purposes of the contract—but they have been reported to run into the hundreds of millions of tons.

This ore would be shipped to United States Steel's Geneva works at Provo to supplement ore from Iron County, Utah.

Construction of a 30-mile railroad from the Union Pacific mainline to the deposits would be necessary for commercial use of the ore, Columbia-Geneva officials said.

Manufacturers Forum

Drill Steel Grinder

THIS AIR-POWERED grinder was designed to withstand rough field handling, according to the manufacturer. Designated the LSB-62G, the 27-lb unit was engineered specifically

for grinding Sandvik Coromant drill steels and automatically sets precision chisel edges. Equipped with standard air hose couplings, the grinder draws 53 cfm of air at a pressure of 85 psi. The grinders are available from either Atlas Copco Eastern, Inc., Paterson, N. J., or Atlas Copco Pacific, Inc., San Carlos, Calif.

Kiln Chain

A CHAIN SYSTEM for wet process kilns in the cement, paper and chemical industries has been announced by Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.

Components of the Thermopruf chain system, which are said to provide longer wearing qualities, greater

corrosion and heat resistance than any steel type kiln chain, include newly designed links and shackles.

A comparatively small inventory of Thermopruf links, connectors, etc., according to the company, enables a user to make any length of chain required for any immediate conceivable condition without cutting and welding. Changing the chain pattern to vary the size of the gas passage in the kiln to obtain different operating conditions is said to be simplified with the individualized Thermopruf chain system, and loop-chain systems with helical suspension or cross-sectional suspension reportedly can be more easily changed or rearranged.

Single-Lamp Charger

AN AUTOMATIC SINGLE-LAMP CHARGER for Wheat Electric Cap Lamps has been introduced by National Mine Service Co., Indiana, Pa. Recommended for use in small and medium sized operations where individual responsibility in charging lamps is the practice, it is also useful for officials, engineers, inspectors and others who may not have access to a regular lamp house.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed. For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

The Wheat Single-Lamp Charger works on 115 to 120 v, 60-cycle current and is equipped with a pilot light which indicates when the battery is on charge. Even when fully charged, the lamp reportedly may be left connected to the charger for hours or a day or two without harmful effect or excessive loss of water.

Idle Control

A COMPLETELY-AUTOMATIC idle control accessory for the Model 35A115 Generator has been announced by Homelite, Port Chester, N. Y. This electro-mechanical control is said to instantly and automatically bring the generator from idle speed to full speed when current is drawn, and to return it to idle speed when power is no longer required. Generator runs at full speed only when power is actually needed.

40-Ton Rear Dump

WITH A 26-CU YD struck capacity, this 40-ton Rear Dump Euclid is known as the R-40. A Twin-Power unit with separate engines, each driving its own rear axle through three-

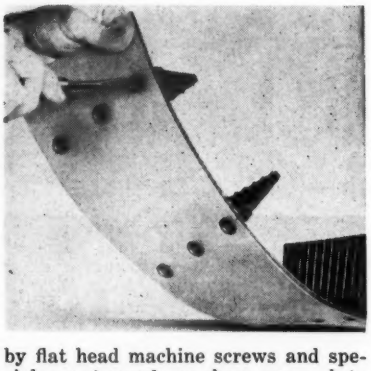
speed Allison Torqmatic Drives, the R-40 is powered by either two 235-hp GM engines or two 250-hp Cummins engines. Both are turbo-charged.

Additional information is available from Euclid Division, General Motors Corp., Cleveland 17, Ohio.

Screw-on Cleat for Belts

A MOLDED NEOPRENE screw-on cleat has been developed that will convert any conveyor or elevator belt into a cleated-belt, according to E. I. du Pont de Nemours & Co., Wilmington, Del.

The cleats are attached to the belt

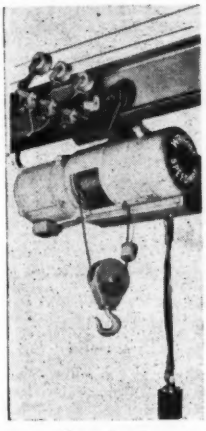


by flat head machine screws and special countersunk washers secured to threaded metal inserts vulcanized in the base of the cleat. Inserts are imbedded in concave cups. When screw is tightened against washer, it pulls belt into cup, and both screw-head and washer sink below surface of belt, where they cannot contact pulley.

Tatch-A-Cleat is manufactured for T. H. Hinchcliffe, 1450 La Loma Road, Pasadena 2, Calif.

Electric Hoist

A TWO-SPEED ELECTRIC HOIST, newest addition to the line of Wright overhead hoisting and traveling equipment, is manufactured by the Wright Hoist Division, American Chain & Cable Co., Inc., York, Pa. This Frame 1, Wright Speedway Electric Hoist, equipped with fractional horsepower 1800/450 rpm motors, provides a fast lifting and lowering speed and a slow, ¼ normal speed, for positioning of production work.



The Frame 1 line, available in parallel mounting, cross mounting, hook mounting and rigid or bolt mounting, utilizes totally enclosed NEMA specification motors for operation on a-c or d-c. The automatic brake, which is immersed in an oil bath, reportedly assures uniform operation in varied atmospheres and safe holding of load while in suspension.

Sheave

ONE AND TWO-GROOVE "Magi-Key" sheaves for quick and easy speed adjustment of "Texrope" V-belt drives in A and B sections has been announced. Designed for low horsepower applications, the Magi-Key sheave provides for increased maximum design horsepower, according to the manufacturer. Keys transmit all rotational torque, i.e., from shaft to hub and hub to discs. The flexibly joined set screw and key give a positive lock between the movable discs and stationary hub.

For Bulletin 20B8524 write to Allis-Chalmers Mfg. Co., 972 S. 70th St., Milwaukee, Wis.

Rock Body

OFFERED IN 6 TO 15 CU YD capacities, a recently developed truck rock body is said to be designed to withstand the severe impact shocks imposed by power shovel, chute and conveyor loading of ore, rock and other abrasive material.

The bodies have ¼-in. steel plate construction in sides, floor and head. For especially severe service, 5/16 or ⅜-in. body shells and wear plates are available. A 15° 24-in. screw end eliminates the need for a tailgate. An optional heater floor is available for use where unusually sticky loads are encountered. Galion rock bodies are designed for mounting on Models 880 or 1000 underbody and Model 77379 telescopic hoists. Capacities range from 15 to 25 tons.

For catalog K-122 write to Galion Allsteel Body Co., Galion, Ohio.

Wrench

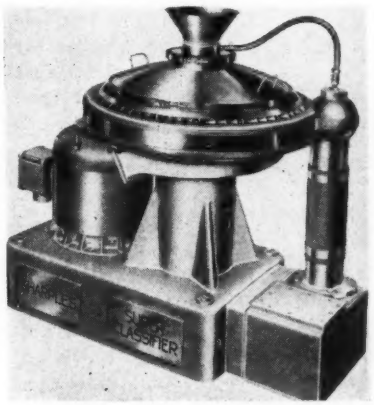
MADE IN THREE SIZES, for all sizes of Flexco nuts, the Flexco Super Wrench can be used in a ½-in. square hole ratchet wrench or with carpenter's brace. The satin finish, chrome plating of the Super wrench resists rust and corrosion. Ask for literature from Flexible Steel Lacing Co., 4607 Lexington St., Chicago 44, Ill.

Dry Powder Classifier

THE OPTIMUM AIR VORTEX classifier is said to provide heretofore unobtainable efficiencies in classifying a broad range of dry powders produced by various industries including mining. Known as the Super Classifier, it increases the precision with which fine powdered materials may be divided by particle size.

Available in four sizes with capacities ranging from approximately 1000 to 30,000 lb per hour, the Super Classifier reportedly provides an ultra-sharp cutpoint at high capacity regardless of feed rate or size distribution in the feed.

A change in desired cutpoint is made by inserting different air vane sets. As a result cutpoint will not vary during a run.



The Super Classifier is designed to classify particles in the range of 10 to 125 microns, average size, depending upon the specific gravity of the material. Operation of the unit is continuous, and once a run is started a minimum of operator attention is required. It is claimed that instrumentation is simple and inexpensive, consisting only of a measurement of air flow rate and the pressure differential across the system.

Write for Bulletin No. 1280 to the Sharples Corp., 2300 Westmoreland St., Philadelphia 40, Pa.

— *Announcements* —

A new plant in Montebello, Calif., will be built to replace and expand **Link Belt Company's** facilities in Los Angeles. Ground will be broken this spring and it is expected the plant will be completed and in operation by November 1957. The Montebello plant will more than double Link-Belt's present manufacturing facilities in the Los Angeles area and will also house the company's factory branch store and district sales office.

Appointment of **Lewis T. Gerlach** as general sales manager of **Kenworth Motor Truck Co.** has been announced. Gerlach has been with Kenworth continuously for 21 years and succeeds **R. D. O'Brien** on the latter's advancement to general manager.

Atlas Powder Co. has broken ground for a new Technical Center to house its Chemical Research and Product Development Departments in Wilmington, Del., to be completed at the end of 1957. Atlas' research and development programs currently are undergoing major expansion, increasing its technical work on present products and processes as well as greatly intensifying its long-range basic research activities. Within the next three years, the company expects to more than double its research and development expenditures and staff.

CATALOGS & BULLETINS

LIGHTWEIGHT ALUMINUM DIESEL TRUCKS. *Autocar Division, The White Motor Co., Exton, Pa.* A series of Autocar lightweight aluminum diesel trucks is described in this folder. Typical weights of the DC 102TL model Autocars and weight distribution are given. In addition to the all-aluminum cab, many other parts of special aluminum are used in the engine, chassis cross members, transmission case and cover, and many other parts. The new models are available with gasoline or diesel power and with either axle-back or axle-forward design.

GRINDING MILLS. *Hardinge Co., Inc., 240 Arch St., York, Pa.* Hardinge's major types of reduction mills for both wet and dry grinding and pulverizing are covered in Bulletin AH-474. Briefly described are Hardinge Tricone, Rod, Cylindrical, Tube, Batch, Conical and Disc-Roll Mills. There is also a brief description of grinding mill accessories and classifying devices.

TUBULAR PRODUCTS, FITTINGS AND FLANGES. *Tubular Products Division, The Babcock & Wilcox Co., Beaver Falls, Pa.* Engineers, buyers and others involved with the problem of determining the proper specifications to apply to various carbon, alloy and stainless steel tubing, pipe, seamless welding fittings and flanges, will be interested in this folder which is a ready cross reference between the steel, the application and the specification covering the product. Reference specifications are those of the

(*Continued on page 172*)

(*Continued from page 171*)

ASTM, AAR and a number of special B & W specifications covering the products mentioned. Folder is identified as TDC-186.

BIT AND ROD SHOP EQUIPMENT. *Ingersoll-Rand, 11 Broadway, New York 4, N. Y.* Covering Ingersoll-Rand's line of bit and rod shop equipment, Form 4187 describes Jackbit grinders for small and large Carset bits and small steel bits; drill steel and bit furnaces for heating to forging temperature and for tempering; drill steel sharpeners, steel cutter and shank grinders; and air motor driven bench and hand grinders.

TORQUE CONVERTER. *Tractor Group, Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wis.* This hydraulic torque converter folder, MS-1140, covers current models of Allis-Chalmers crawler tractors.

CORE DRILLING MACHINE. *Sprague & Henwood Inc., Scranton 2, Pa.* Bulletin No. 350 covers Sprague & Henwood's Model 30 Core Drilling Machine. It describes and illustrates the features of this machine, and contains specifications and types of mountings which are available.

CENTRIFUGAL PUMPS. *The Allen-Sherman-Hoff Pump Co., 259 East Lancaster Ave., Wynnewood, Pa.* Describing centrifugal pumps for handling abrasives, corrosives and acids, Brochure No. 956 features the interchangeable Hydroseal and Centriseal rubber-lined Slurry pumps that offer a choice between the Hydroseal's added protective flow of sealing water and the Centriseal's ability to deliver abrasive or corrosive pulps undiluted. Hydroseal Sand, Dredge and Vertical Sump pumps are also pictured.

GENERATOR SETS. *Detroit Diesel Engine Division, 13400 W. Outer Drive, Detroit 28, Mich.* Brochure includes specifications and illustrations of over 25 radiator — and heat exchanger — cooled models ranging from 20 to 245 kw. Both 50 and 60 cycle and d-c units for emergency standby and continuous off-the-line use are represented. Features of the two-cycle Detroit Diesel engines which operate the sets and automatic starting and shut-down equipment are covered.

PAINTING, UNDER-COATING AND SURFACE PREPARATION SPECIFICATIONS. *G. L. Industrial Coatings, Inc., Division of Great Lakes Paint & Varnish Co., 2201-35 North Pulaski Rd., Chicago 39, Ill.* G. L. Industrial Coatings, Inc., has announced the first of painting, under-coating and surface preparation specifications developed specifically for each industry and its subdivisions. They cover the steel industry and concentrate on blast furnace and rolling mill painting.

SINGLE ROLL CRUSHERS. *McLanahan & Stone Corp., Hollidaysburg, Pa.* Rockmaster Single Roll Crushers are the subject of Bulletin RMTD-56. The publication includes data on all principal components of the crushers, as well as material on the development of single roll crushers. A parts list with drawings and information on applications also are features.

STORAGE BATTERIES. *Yardney Electric Corp., 40-50 Leonard St., New York 13, N. Y.* Entitled, "Compact Power by Yardney," this booklet on Yardney's line of Silvercel (silver-zinc) and Silcad (silver-cadmium) rechargeable storage batteries includes a complete set of technical data sheets giving the latest physical and electrical specifications of available cells and batteries, varying in size from a fraction of an ampere hour to many thousands of ampere hours. An application questionnaire is also provided for designers and engineers requiring cells of special design.

VERTICAL TURBINE PUMPS. *Layne & Bowler, Inc., Memphis 8, Tenn.* The 72-p. book entitled, "The Answers to Your Questions About Layne Vertical Turbine Pumps," covers the use of pumps for municipalities, industry and irrigation. The entire text is supplemented with graphic tables, photographs, drawings and charts. It is said to be a thorough and all-inclusive reference book on vertical turbine pumps. Requests for copies must be sent on company letterhead.

DRILL STEELS, BITS AND ACCESSORY EQUIPMENT. *Brunner & Lay, Inc., 9300 King St., Franklin Park, Ill.* Brunner & Lay products are featured in a 20-p. catalog No. 756 which includes carbide rock-bits, drill steels and pneumatic tool accessories — such as moil points, sabur points, clay spades and asphalt cutters. Pictures and specifications are given for each product.

TRANSVERTER. *Transmission Division, Clark Equipment Co., Jackson, Mich.* Bulletin No. TV-100 describes the "Transverter" power train package designed for off-highway and stop-and-go service. The three major components—torque converter, disconnect clutch and transmission — are illustrated. There is also a cutaway diagram of the assembled unit. Data included in the bulletin indicate that it is rated for engine torque up to 325 lb ft and that it is only eight in. longer than a conventional transmission and clutch.

Index to Advertisers

FAIRMONT

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Motorman requests right-of-way from dispatcher

Underground shop receives maintenance orders

How M·S·A MinePhones boosted existing haulage efficiency to handle Powhatan's increased production

With new continuous mining machines and fast-moving shuttle cars funnelling coal to a seven-mile, single-track system from 12 faces, Powhatan Mining Company officials faced the fact that production would "out run" haulage unless a plan could be devised to make existing facilities adequate for the job.

They found the answer in M.S.A. MinePhones. Twelve of these units were installed in the Company's No. 3 mine and another twelve at the No. 1 mine, near Bellaire, Ohio. The new system gives the dispatcher instant, continuous, two-way voice communication contact with locomotive motormen, the underground maintenance shop, and a "jeep" which carries men, and acts as an emergency vehicle. Now, haulage decisions are made quickly, keeping trips moving, minimizing "waits" on sidings. Repair needs are relayed "on the double," over-all safety has improved.

We will be happy to discuss your haulage system, and show you how M.S.A. MinePhones can aid efficiency, increase safety. Write for complete details.

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